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UNIVERSITY OF ALBERTA

Job Structure, Organizational Structure, and Creative Performance in Business Firms Engaged in Creating New Products

by

Rodney Earl Brandvold

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND

RESEARCH IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

DEPARTMENT OF EDUCATIONAL PSYCHOLOGY

EDMONTON, ALBERTA

SPRING 1989

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FACULTY OF GRADUATE STUDIES AND RESEARCH

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submitted by Rodney Earl Brandvold

in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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Abstract

This study examined whether job structure and organizational structure were related to creative performance in organizations engaged in inventing and creating new products.

Thirty-nine Saskatchewan companies designated as high-technology firms by the provincial government participated in the study. From these, each CEO and 117 idea generators responded. Idea generators were defined as employees expected to be currently inventing and creating.

Creative performance consisted of: (1) creative quality--CEO ratings of success at inventing and creating new products, and (2) product quantity--number of inventions or creations per idea generator per year, weighted for long-term.

Organizational structure consisted of structuring of activities and concentration of authority. Job structure consisted of motivating potential as computed from five job dimensions.

Climate for creativity and innovation, and worker characteristics were statistically controlled. Size, company age, and dependency, as well as job satisfaction were statistically controlled as covariates of the independent variables.

Pearson correlation, partial correlation, multiple correlation, ANOVA, and ANCOVA were utilized.

Companies were small, young, and independent employing as idea generators mostly young, well educated, males.

Product quantity was significantly, negatively correlated with structuring of activities, and positively correlated with concentration of authority, even when size, company age, and dependency were controlled. Structuring of activities accounted for more of the variance than concentration of authority. Elements of creative organizations, idea-generator age, years of education, and creative ability covaried with product quantity, the last three negatively. Idea-generator age accounted for the most variance in product quantity, followed by structuring of activities. The ANOVA with product quantity and structuring of activities was significant. ANCOVA with idea-generator age and years of education as the covariates was also significant.

Job structure correlated significantly with structuring of activities. More variance in job structure was accounted for by job satisfaction than by structuring of activities; and more variance in structuring of activities was accounted for by size and

dependency than by job structure.

Managers can expect that when product quantity is high, structuring of activities will be low, i.e., there will be few specialized functions and few role defining documents.

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Chapter One

Introduction

Hackman (1983), introducing a section entitled "Attributes of Organizations and Their Effects on Organizational Members" in Marvin Dunnette's Handbook of Industrial and Organizational Psychology (1983), wrote that we know a good deal about "the attributes of individuals which are important for understanding behavior in organizations; [but] less is known about" (p. 1065) how characteristics of the organization itself impact upon behaviour.

Staw (1984) in his review of organizational behaviour literature observed that as work becomes more highly skilled and professionalized "the criteria of performance will likely become ambiguous and subject to change . . . [particularly] in situations where markets are rapidly changing or competition fierce" (p. 655-6) and therefore, research on creativity and innovation will become increasingly important. After briefly commenting on the existing literature, Staw concluded that "what is sorely needed at the present time are empirical studies . . . , [and the] significant and difficult work that needs to be undertaken is the examination of how individual, group, and organizational factors interact to make an organization

creative" (p. 656-7).

The majority of literature on management of creativity and innovation to date, although drawing firm conclusions, has been descriptive and has taken a case study or anecdotal approach (e.g., Peters and Waterman, 1982; Kanter, 1983; Peters & Austin, 1985). Conceptual literature regarding the effects of technology on organizational structure has led to the conclusion that for companies to be successful at inventing and creating new products they should be low on indices of structure (Daft, 1983). A review of the job analysis (job characteristics) and organizational structure literature in Psychological Abstracts from 1977 to 1988 turned up no empirical studies that had examined relationships between organizational structure or job characteristics and organizational success at creative performance.

In response to the lack of empirical studies in this particular area, the present one was undertaken. This was a descriptive, correlational, field study which used questionnaire survey methodology. The author examined the effects of job structure and organizational structure on creative performance in 39 companies in Saskatchewan that were engaged in inventing or creating new products. The specific

purpose was to conduct an initial examination of whether job and organizational structures were related to creative performance, and whether more successful firms could be differentiated from less successful ones using job and organizational structure variables.

The success of a company at inventing and creating depends on many factors. Some factors are external existing in the marketplace; others are internal such as culture and management practices (Ahlbrandt & Blair, 1986); and still others are related to the skills and experiences of the companies' human resources (Galbraith, 1982). To determine whether there was any relationship between structure and creative performance, the effects of these other factors had to be statistically controlled. Organizational structure is known to be affected by such factors as size (Ford & Slocum, 1977), and employee ratings of job structure may be influenced by job satisfaction (Hackman & Oldham, 1980). These were statistically controlled as well.

In Saskatchewan, the Department of Science and Technology maintained a list of firms which they referred to as high-technology companies. This was a convenient list from which to identify a sample of firms engaged in invention and creation. The

Department had listed over 160 advanced technology companies; 95 had more than four employees, and of these 58 were found to be engaged in inventing or creating new products.

Generally, the results of this study have implications for situational determinants of behaviour. They have implications for management of any group that is engaged in creative performance, whether a classroom for the gifted, university faculties, or R & D labs. More directly, the results have implications for how any enterprise that depends on the creative products and responses of its workers should be organized in order to stimulate and maintain creativity.

Limitations

1. Because a convenient sample of companies was used, the results are limited in their representativeness. Until proper sampling methods are used in follow-up research, generalizations are limited.
2. Because this study was conducted in a field setting it was not possible to control all the relevant variables but only some of them. The rigor achieved was only to the extent that conditions would allow.
3. Because this study utilized questionnaire survey methodology it was subject to limitations due to response bias. Perceptual set, halo effect, failure of

memory, and even reluctance to disclose true ratings were possible sources of bias.

4. Because this was a correlational study, it could not identify cause-and-effect relationships.

Delimitations

1. The results of this study apply only to Saskatchewan firms on the Department of Science and Technology's 1987 high-technology list, with more than four employees, that were engaged in inventing, creating, designing or developing new products, new services, new solutions or any form of scientific research.

Chapter Two

Review of the Literature

This chapter presents a review of the literature on creativity, innovation, organizational structure, and job design.

In the first four sections creativity, inventiveness, and innovation are defined; the literature on climate for creativity and climate for innovation are reviewed; and a model identifying the essential elements of creative and innovative organizations is presented as a summary of the two sections on climate. Following this, the next three sections review and discuss the literature on organizational structure, the effects of technology on organizational structure, and the relationships between various dimensions of organizational structure and creative performance. Next, an overview of job structure and a discussion of the relationship between various dimensions of job structure and creativity are presented. The final two sections present a summary of the chapter, and outline the research questions addressed in the rest of the study.

Definition of Creativity, Inventiveness, and Innovation

Barron and Harrington (1981) found in their review of the literature that creativity was used most commonly

to refer to (1) "socially recognized achievement in which there are novel products to which one can point as evidence, . . . [and] (2) an ability manifested by performance" (p. 442). Creativity is also found to refer to a process through which novel products are produced (Amabile, 1983a; Stein, 1974).

Webster's (1983) defines creativity as both an ability, through imaginative means, to bring something new into existence, and the quality of being so brought into existence. Attempts to clarify the attributes of a creative achievement have commonly included novelty or statistical infrequence (MacKinnon, 1962; Stein, 1974; Vernon, 1970) and rule-boundedness, acceptability and fit (Bruner, 1965; MacKinnon, 1962; Pearlman, 1983) or social value (Vernon, 1970). Also found are reference to elaboration and full development (Besemer and Treffinger, 1981; MacKinnon, 1962), the judgment of creativity being made by significant others (Amabile, 1982; Pearlman, 1983; Stein, 1974) at some point in time (Stein, 1974) and the path to solution involving heuristics rather than algorithms (Amabile, 1983a; Bruner, 1965).

In the present study, the main focus is on creative achievement. Creative ability is treated as a control variable, as is creative process, the latter as

elements of the work environment that facilitate creativity and invention.

Creativity is here defined as bringing something new into existence. In Webster's (1983) the term invent is given as a synonym for create, with any difference being that invent "implies fabricating something useful" whereas create implies "producing a thing for the sake of its existence rather than its function or use."

When discussing creativity in industry, the term innovation seems to be preferred (e.g., Lasswell, 1959). It is difficult to obtain clear distinctions among creativity, invention and innovation. For example, Galbraith (1982) defined invention as "the creation of a new idea . . . [and] innovation [a]s the process of applying a new idea to create a new process or product" (p. 6). This definition embodies the notion of creativity and, to the extent that processes or products can be assumed to be useful, it also includes invention.

White (1975) was of somewhat more assistance. He considered invention as the end product of research, and innovation, which he considered to follow invention, as the end point of successful development. He offered a further distinction from Mohr: "Invention

implies bringing something new into being: innovation implies bringing something new into use" (cited in White, 1975, p. 9). Although, there is still some overlap of the two concepts, the distinction is helpful. This notion of introduction of something new as opposed to bringing something new into existence seems to be the essence of Webster's distinction between innovation and creativity or inventiveness.

A definite distinction is drawn here between the type of innovativeness discussed above, i.e., as an attribute of a product, (often referred to as technological innovation in industrial settings), and innovativeness as an attribute of an organization (referred to as organizational innovation). Organizational innovation is clearly treated in the literature (e.g., Daft & Becker, 1978) as the process of an organization adopting something new, and as being independent of creation of something new. This study did not address organizational innovation.

An example of a process definition for technological innovation is "the process by which industry generates new and improved products and production processes. It includes activities ranging from the generation of an idea, research, development and commercialization to the diffusion throughout the

economy of new and improved products, processes and services" (Walcoff, Ouellette & Cheremisinoff, 1983, p. 1). Various models of technological innovation portray it as consisting of several stages, for example, initiation, adoption and implementation (Abbey & Dickson, 1983), or initiation, problem solving, and implementation (Ebadi & Utterback, 1984). These models are often described sequentially or as "pipelines." Inventiveness and creativity may only be involved at the beginning of such innovation processes. However, it is argued in the literature that there is a role for these qualities at all stages of the process. In particular, inventiveness and creativity are essential throughout, when the innovation process is viewed via a 'concomitance model' (Schmidt-Tiedemann, 1982) which suggests research, technical and commercial functions go on simultaneously, with quasi-continuous interaction throughout the phases and temporal sequence of tasks.

The part of the innovation process that most resembles the creative process is the early stage, i.e., the stage referred to as initiation or as idea generation. It would not include later stages of commercialization, diffusion, adoption or implementation.

To summarize, creativity involves bringing

something new into being; invention implies bringing something useful into being, and innovation implies bringing something into use. Creativity is part of inventiveness, and both are part of innovation.

This study was restricted to the concept of creativity and early innovation. Inventiveness was treated as synonymous with creativity. Literature dealing with innovation was included when it appeared to embrace the same construct. For purposes of this study, the terms creativity, inventiveness, technological innovation and innovation were used interchangeably.

Climate for Creativity

Before examining the role of job design and organizational structure in creativity, it is important to understand the nature of the general conditions within an organization that affect creativity. In this section literature is reviewed that addresses climate for creativity.

In the 1950's, 60's and early 70's, the vast amount of work on environments for creativity focused on classrooms (Anderson, 1959). Creativity could be enhanced, it was believed, through the right interpersonal environment combined with stimulation of cognitive processes in service of creativity (Barron,

1972).

MacKinnon (1962) studied the creativity of successful architects. He highlighted the particular environment needed--while growing up and in the school system--for developing creativity, but he did not go beyond to suggest or even speculate on the nurturing of creativity in work environments. He seemed to imply that once one's store of creative potential had been developed, there was no longer a role for the environment to play in facilitating on-going creative output.

MacKinnon's observations could be summarized as follows. Successful architects' childhood climate was characterized by respect, freedom, lack of intense closeness, effective and resourceful role models, clear standards of conduct, development of personal ethical codes, enrichment of cultural and personal experiences, and interest and skill in drawing and painting. School climate was characterized by caution in setting limits, flexible discipline and self control, equal weighting on training in criticism and perceptiveness, strengthening of intuition, learning of reasoning skills as well as large bodies of facts, independence of thought and action, and tolerance for questioning of authority and nonconformity.

In 1972, Calvin Taylor edited Climate For Creativity. In his observations of organizations he found that not enough had been done to nurture creativity. There did not seem to be a recognition in work organizations that special circumstances may be required. He listed circumstances that would stifle creativity. These revolved around supervisory assumptions, attitudes, interpersonal behaviours and rewards.

In the midst of a focus on classroom and home climate for creativity there were occasional references to the work setting. For example, McPherson (1964) noted that "it has become increasingly apparent that capable supervision, adequate rewards and recognition, sensible communication, and an organization that does not frustrate their efforts are needs vital to the success of most scientists" (p. 146). But even in industrial settings the most important dimension was considered to be interpersonal process (Gibb, 1972). For example, Gordon (1972) maintained that "scientific creativity is mediated through interpersonal processes" (p. 124). And even McPherson (1964), in the same article as quoted above, goes on to say "neither manipulation of facilities nor arguing of pros and cons of decentralization versus centralization is nearly so

important as improvements in the quality of interaction between the potentially creative person and the 'significant others' in his environment--namely, his boss and his work group" (p. 152). The emphasis on interpersonal relations seemed to follow the influence of the human relations movement in management (Mayo, 1945). The prescription for improving the climate for creativity was sensitivity training and team development (Gibb, 1972; McPherson, 1972).

Haefele (1962) was unusual among these early writers on creativity to be concerned about the industrial climate and to go beyond interpersonal relations in attempting to facilitate creativity. He counselled compromise "between the optimum creative climate and total organizational maintenance and discipline" (p. 178). His prescription included six changes the organization should make to enable creative people to be creative: (1) establish dual career ladders; (2) provide recognition; (3) put their inventions to use; (4) provide freedom from the "organization's need to maintain control and management's need to have its finger on the pulse of all organizational activity" (p. 184); (5) provide routine-type services such as clerical, laboratory, engineering, and consulting; and (6) select and train

creative people "to match the degree of creative climate the company is able to provide" (p. 189).

Steiner (1965) summarized the presentations made at a 1962 seminar on the creative organization. The seminar addressed the question "What, specifically, can management do--beyond selecting creative participants--to foster creativity within and on the part of the organization?" (p. 19). Steiner listed five areas that needed attention: (1) values and rewards; (2) compensation; (3) channels for advancement; (4) freedom; and (5) communication.

Pelz and Andrews (1966) reported the results of a major study which attempted to identify the components of a stimulating environment for research personnel. Many of the features they identified as environmental were actually attributes of the scientists themselves, for example, allowing other scientists to influence their direction, maintaining an interest in both "application" and "pure science," and interacting vigorously with colleagues. Several years later Pelz (Pelz, Meyer & Gellerman, 1975) presented a model differentiating more clearly between individual and environmental attributes. To be stimulating the environment needs to be characterized by a reputation for technical achievement, adequate resources, a

mechanism for reporting and making visible the achievements, recognition, and mechanisms to increase exposure to new and more challenging problems. He postulated that superior problem-solving emanated from a creative tension between security and challenge, and emphasized that the role communication bonds and barriers play in that must be understood.

Owens (1972) in measuring correlates of mechanical ingenuity among mechanical engineers found evidence for a complex combination of determinants of creativity. The largest of these was a measure of the environment which he labelled Professional and Research Orientation of Supervision. It consisted of the following characterization of job environment: "the head of [the] department publishes, . . . colleagues hold advanced degrees; the company provides out-of-hours laboratory facilities for personal research; the head of [the] department has contributed to patents pending or held; and the head of the department has an M.S. or Ph.D. in engineering" (p. 263).

Stein (1974; 1975), relying primarily on research evidence, concluded that creativity can be stimulated. His work focused more on techniques for technological and consumer-related product areas than arts and humanities. His first volume (Stein, 1974) focused on

procedures to help individuals and the second volume (Stein, 1975) contained procedures for groups. For Stein (1975) "creativity occurs in a social context and is a function of the transactional relationships between the individual and his environment--the creating individual is both affected by and affects his environment" (p. xii).

By this point, the notion of interpersonal relations on a one-to-one level had been expanded to a climate or collective-culture concept. There seemed to be a movement away from focusing on micro interpersonal skills and toward focusing on a milieu of valuing, supporting and encouragement of the creative person and the creative act. However, this milieu, referred to as culture, was still established and maintained on building blocks reflecting the substance and quality of one-to-one transactions.

To assess the appropriateness of the environment, Stein (1975) argued that several aspects of the organization needed to be explored. These were the organization's value system; communication system; power structure (hierarchy); quality of all levels of personnel; and quality of the physical plant.

Amabile (1983b) noting "there is only a modest amount of research on stimulating creativity in the

sciences and industrial organizations" (p. 200), made the following suggestions from her own and other social-psychological research regarding organizational climate.

> Inhibiting factors include: (a) a fear of failure, which results in reluctance to take risks; (b) a preoccupation with order and tradition; (c) a failure to see one's own strengths and the strengths of others in the organization; (d) an over-reliance on ineffective algorithms; (e) a reluctance to assert one's own ideas; (f) a reluctance to play; and (g) an excessive use of salient reward. . . . [Favourable] conditions include: (a) a climate conducive to new ideas; (b) an organizational structure flexible enough to bend with whatever strain innovation may bring; (c) an established process for developing new ideas into products; and (d) support for innovation from the highest levels of management" (p. 202).

Freedom. Perhaps the most consistently named influence on creativity is freedom to choose the problems to be worked on and to pursue them in one's own way. And perhaps of most importance is freedom to pursue them in ones own way if choice of problem can

not be allowed. Many writers emphasized how important this is and research (e.g., Amabile & Gitomer, 1984) has shown that choice in materials and methods really does lead to greater creativity.

Of all the necessary conditions, this is perhaps the most related to the creative process. By Amabile's (1983a) definition, for example, it is not possible to achieve creative products or responses if existing algorithms are used. The task must be heuristic. Individuals must be free to choose their own heuristics to apply, and as in thinking processes or problem solving (Newell, Shaw & Simon, 1962), must be free to explore whatever cognitive pathways they choose and truncate and switch to others as they see fit. This more than anything else points out how the creativity process is inescapably interwoven with the thinking process.

Kohn and Schooler (1982) found occupational self-direction to lead to greater ideational flexibility. Self-directed jobs tended to have greater substantive complexity. They suggested that it is the substantive complexity of self-directed work which "has the strongest direct effect on ideational flexibility" (p. 1270). MacKinnon (1962) found that creative people prefer complex and asymmetrical tasks. It would seem

that by affording self-direction there is a greater likelihood of creative workers achieving the level of complexity they desire and perhaps need.

It is important to keep in mind that the focus here is on creativity and not on productivity. Freedom is certainly likely to interfere with productivity. Productivity may benefit through imposing certain controls and by formalizing or standardizing certain processes and activities. But if creativity is the goal then freedom must be maintained.

Not only are personality characteristics likely different at different stages of the innovation process (Parloff, 1972), it is likely that the optimum environmental factors are different at different stages as well, and may differ for different people (Amabile, 1983b).

In summary, the foregoing literature on climate for creativity suggests a number of environmental characteristics that are required if creativity is to be fostered. These are:

1. Supportive interpersonal relations.
2. Rewards, compensation and recognition, such as dual career ladders, for creative workers that facilitate intrinsic motivation.
3. Organizational values and culture that prize

creativity and professionalism in research.

4. Freedom to choose the problems to be worked on and to pursue them in one's own way.

5. Open communication systems.

6. Resources and services in support of creative workers. This includes talented and properly trained personnel.

Climate for Innovation

In this section, literature is reviewed that deals with climate for innovation.

Galbraith (1982) contended that to be creative and innovative the "organization's structure, process, rewards, and people must be combined in a special way to create an innovating organization" (p. 6). Innovating organizations were those "designed to do something for the first time ...[as opposed to those] designed to do something well for the millionth time" (p. 6). The latter type he referred to as operating organizations.

Burns and Stalker (1968) concluded that the process of innovation required organic organizations as opposed to mechanistic ones. Their description of organic organizations included free flowing information, crossing of organizational lines to bring in whomever was needed on a problem, and blurring of

hierarchical position.

For Galbraith (1982) innovating organizations must explicitly and formally establish the roles of idea generator, sponsor, and orchestrator.

Sponsorship and orchestration. The idea generator seldom has the status or power in an organization to bring his ideas through the testing, development and commercialization stages. Even without a deliberate political maneuver to squelch a new idea, noncreative people can thoroughly discourage creativity by over-analysis (Schleh, 1983).

The sponsor's role, also referred to as product champion, is to support the idea generator, promote the idea itself, provide protection and encouragement, and commit resources while playing the "God father" (Ahlbrandt & Blair, 1986; Galbraith, 1982; Mendell & Ennis, 1985; Roberts, 1979).

For Peters and Austin (1985) sponsorship and orchestration involved running interference. By this they meant providing assistance to overcome the constraints of the bureaucracy. They found that companies well organized formally for innovation understood the need for the interference runners.

The orchestrator role must be performed by someone with the power and authority to realign the

organization toward innovations.

> An orchestrator is necessary because new ideas are never neutral. Innovative ideas are destructive; they destroy investments in capital equipment and people's careers. The management of ideas is a political process. The problem is that the political struggle is biased toward those in the establishment who have authority and control of resources. The orchestrator must balance the power to give the new idea a chance to be tested in the face of a negative establishment (Galbraith, 1982, p. 11).

Lots of tries, lots of starts, lots of fails. Peters and Austin (1985) wrote about lots of tries, and lots of starts in a general climate of experimentation. They found the best ratio of success to tries of new products in the market place was one in 20. This did not include the hundreds of tries that were rejected in the lab.

In order for there to be lots of starts and lots of tries, there should be acceptance of lots of failures (Amabile, 1983b; Galbraith, 1982; Mendell & Ennis, 1985; Shapero, 1985). It should be safe to try and to fail. Risk taking should be rewarded and failure not penalized (Ahlbrandt & Blair, 1986).

Another antecedent of lots of tries and lots of starts is a persistence or dogged determination that should be characteristic of the creative worker. Amabile (1983b) referred to this as a conducive work style. "Innovation is work. . . . When all is said and done, innovation becomes hard, focused, purposeful work making very great demands on diligence, on persistence, and on commitment. If these are lacking, no amount of talent, ingenuity or knowledge will avail" (Drucker, 1985, p. 138). Practice, trying, and starting are critical to the creative process. Environments should encourage and facilitate experimentation and playful exploration which are considered the right frame of mind and atmosphere for creativity (Amabile, 1983b; Shapero, 1985)

Rewards. Intrinsic versus extrinsic rewards are more salient for creative work (Amabile, 1983; Galbraith, 1982). The outcomes of value to the individual seem to relate to being part of a successful organization with a reputation for good work--good science, opportunities to pursue one's ideas, promotion and recognition systems, and special compensation (Galbraith, 1982). The last type should be used cautiously. Knowing that the organization has been successful, or an advancement in knowledge or

technology has occurred, partly through their efforts, is rewarding. Sponsors need rewards as well.

Sarett (1979), Lehr (1979), and Galbraith (1982) indicated that dual career ladders were necessary incentives as they provided for promotion and recognition in response to innovative performance. Pinchot (1985) suggested that providing intracapital--large amounts of capital to be used for new projects of the innovator's choice within the corporation--was a workable reward system.

Peters and Austin (1985) emphasized that tangible, monetary rewards must not be too large.

> Surprisingly, much of the momentum for constant innovation can be badly stifled when the rewards for innovation get too big. The $100,000 award creates a superstar syndrome. The subtle message is "Only a few people can do it." [In successful companies] . . . a large share of the population can and should be innovating--regularly. Winners, big and small, are touted to the skies, but principally via nonmonetary compensation. It seems an iron law: When the rewards structure gets too lumpy (marked by sporadic, big hits), people start hiding things to enhance the probability of their getting the credit and the big one.

> Sharing, cooperation and emergence of a bunch of tiny, cooperative teams are unintentionally stifled, remarkably quickly (p. 190).

Meaningful work. Kidder (1981), in his novel about a group of engineers designing and building a new computer, highlighted the motivational effect of the opportunity to work on something big and important. Throughout the project, the working engineers frequently commented on how they would not get such a chance working for other companies.

Embedded in this issue of big, important and significant work are the issues of responsibility and trust. The new engineers felt responsible for the future success of the company. This stemmed from their belief that what they were working on would give the company the competitive edge. Feeling very responsible for overall corporate success contributed to the importance they placed on their work. Therefore, felt responsibility and potential impact of their work seemed to contribute to their perception of the importance and significance of their work. It both puzzled and inspired the workers in Kidder's (1981) account that senior management would trust them with so much responsibility.

Herzberg (1968) as well included a s nse of

responsibility as one of his motivators. Hackman and Oldham (1980) used the term responsibility to refer to a sense of personal accountability for the work outcomes.

Financial resources. Funding is essential for innovation, not only the dedication of enough ongoing funds but additional or special funding for research or the development of new ideas or products--those opportunities that were not foreseen when the budget was set (Galbraith, 1982; Merrifield, 1979; Schleh, 1983).

Data and material resources. Adequate, and preferably exceptional, facilities, data and information are required to enable creative work (Allen, 1977; Shapero, 1985). With inadequate materials, advancement of knowledge is obstructed by limitations inherent in the supporting technology. Thus libraries, data banks and methods for efficiently accessing these sources are essential for advancements.

Communication and information flow. The existence of data resources is one thing, but to stimulate creativity, data must flow and be accessible to all (Allen, 1977; Lehr, 1979; Merrifield, 1979; Roberts, 1979). The process of dissemination and exchange of data in an organization can be referred to as the

communication process or information flow. Information here refers to not only what goes on within an organization such as customer requirements, corporate strategies, priorities, and preferences, internal resource availability, future projections and environmental assessments, but also the state of the art in the domain generally, i.e., new and emerging technology, solutions tried elsewhere, others' successes and failures, the competitions' goals, trends, industrial policy and government philosophies and availability of external funding and other services and resources.

From a cognitive psychology point of view, large amounts of knowledge are essential for creativity to take place. The probability of combining cell assemblies in new and different ways is vastly increased with greater stores of information (Amabile, 1983b).

Putting interdependent functions within an organization together in very close proximity facilitates information transfer and crossing of organizational lines. Relaxing hierarchical structures makes it possible for those lower down who are usually the idea generators to receive data and information from those higher up, thus assisting vertical as well

as horizontal information transfer (Steiner, 1965).

Being part of the "strategic information stream of the business" (Peters and Austin, 1985, p. 216) is key to inducing a sense of ownership which is considered essential. Ensuring that people are included in the information flow counters the "NETMA (Nobody Ever Tells Me Anything) factor" (p. 216) which eventually erodes motivation.

Another purpose for information flow is feedback. Hackman and Oldham (1980) identify one of their critical psychological conditions for internal motivation as "knowledge of the actual results of the work activities" (p. 73). They insisted that people must receive "ample information about how well . . . [they are] performing" (p. 73).

Newell et al. (1962) stated that feedback signaled achievement of the solution to a small problem which was a step to the solution of the larger problem.

If feedback on performance is inherent in doing the task itself, such as in hitting a golf ball, then feedback is direct. However, most work does not involve immediate, inherent feedback; others are depended upon to provide information on performance effectiveness. To the extent that information flow can be established and maintained to immediately inform

potential creators regarding the efficacy of attempted solutions, the likelihood of achieving novel and workable products or responses is greatly increased.

Human resources. Care and attention must be given to the selection and recruitment of talented, qualified people if creativity is to flourish (Galbraith, 1982; Haefele, 1962; Shapero, 1985; Stein, 1974). Not only having enough people but the quality of people and the knowledge and special characteristics they possess are important. The qualities required seem to include intimate knowledge, cognitive and perceptual abilities, and technical skill (or talent) in the particular domain, appropriate cognitive style, conducive work style, attitudes, intrinsic motivation and knowledge of heuristics for the task (Amabile, 1983; Galbraith, 1982; Gardner, 1982; Gruber, 1974)

The provision of human resources should not overlook support services. These range from clerical and stenographic, to research assistance, drafting, editing, and commercial evaluation, and are required to unburden the idea generators and free their time to pursue creative solutions.

Culture. Along with the provision of resources, a prevailing culture needs to exist made up of organizational values and norms that prize creativity

and hold some reverence for the act (Ahlbrandt & Blair, 1986; Lehr, 1979; Owens, 1972; Peters & Austin, 1985; Sarett, 1979).

A culture for inventiveness is enhanced if managers and supervisors are seen as producing creative products themselves either through publications or tangible visible evidence of machines/apparatus/ products they have produced and further legitimize creative efforts by being educated or trained in the area (i.e., serve as models) (Mars, 1981; Owens, 1972). A creative culture and past successes lead to a reputation which serves to attract and inspire those who work there (Sarett, 1979).

Peters and Austin (1985) maintained that management's task is to create a climate to induce experiments and champions. From their point of view the right climate is established through norms, culture, language and stories that legitimize the sloppiness and non-rational disorderliness of innovation and the need for cheating; living by the action oriented credo "Try it, now;" encouraging lots of tries with acceptance and nonpunishment of failures; leaving projects out "on the bench"; bringing together interdependent functions and yet allowing semi-isolation; decentralizing and encouraging people to

overcome the constraints of budgets, bureaucracy and schedules and acknowledging as rascals, but worshiping as heroes, those who do; nurturing champions; worshiping as heroes those who have been successful innovators; providing non-monetary rewards; and developing ownership through information flow and trust.

As one would expect, perception plays a major role here. Workers need to perceive that the organization prizes creativity. Therefore, the onus is on management to demonstrate, communicate, illustrate, remind, etc. This is done through the constant telling of stories and the language used, especially by senior managers, and by the ceremonies, rituals and celebrations regularly held. (Galbraith, 1982; Peters and Austin, 1985; Schneider & Reichers, 1983).

Galbraith (1982) used the term differentiation to mean keeping the innovating part of the organization separate from the operating part during the idea generation stage, but close enough that collaboration during the implementation and transfer stage was not precluded. "The less the dominant culture of the organization supports innovation, the greater is the need for separation" (p. 14). Some companies, Drucker (1985) wrote, the more successful ones, even set up the

innovative project as a separate business.

Reservations or skunkworks. Reservations are the kinds of small, separate organizational units with "garage-like atmospheres" through which differentiation can be operationalized. These are safe havens in which to risk, to try, to innovate, to fail, to "learn, and ultimately perfect a new idea" (Galbraith, 1982, p. 14). They are buffered from the administrative structure and requirements of the operating organization. Their separateness or isolation affords this buffering and also aids in group cohesiveness, identity and teamwork. Peters and Austin (1985) referred to reservations as skunkworks and argued that they are essential.

The key is that skunkworks operationalize the other conditions essential for creativity. They concentrate data, people, things and money, with a manager who runs interference for the group, getting them what they need and buffering them from the requirements of the larger organization. Information flow within the group is intense. Group members are free to experiment, take risks, fail and learn without fear of sanction. People from different functional areas or disciplines work side by side as colleagues, supporting one another and handing off projects,

processes and ideas back and forth, thus maximizing each other's expertise.

Sometimes the entire organization functions as a skunkworks. Mintzberg (1981) referred to free-flowing organic structures as Adhocracies. They tend to be younger organizations that have "project structures" that "fuse experts drawn from different specialties into smoothly functioning creative teams" (p. 111). When organizations need to innovate in complex ways they find that bureaucracies are too inflexible and simple structures are too centralized. Adhocracies are complex and nonstandardized.

But, skunkworks or reservations are not without their limitations. And, they are certainly not the way to go if productivity is the goal. As Mintzberg (1981) points out,

> Adhocracy in some sense achieves its effectiveness through inefficiencies. It is inundated with managers and costly liaison devices for communication; nothing ever seems to get done without everyone talking to everyone else. Ambiguity abounds, giving rise to all sorts of conflicts and political pressures. Adhocracy can do no <u>ordinary</u> thing well. But it is extraordinary at innovation (p. 113).

A Model for Elements of Creative Organizations

Considering the characteristics of environments for creativity, summarized earlier, along with those for innovation discussed above, there are many similarities. The material on innovation verifies and adds to what is already known about creativity. Both bodies of literature could be summarized by the following model listing the essential elements of creative and innovative organizations.

Elements of Creative Organizations

1. Resources
   - Data Resources
   - Human Resources
   - Material Resources
   - Financial Resources
2. Culture
   - Valuing and prizing creativity
   - Reputation for innovation
3. Motivators
   - Big, important opportunities
   - Recognition and Rewards
4. Enablers
   - Communication/Information Flow
   - Freedom
   - Skunkworks

Lots of starts, lots of tries, lots of fails

Sponsorship and Orchestration

The Structure of Organizations

Having reviewed the climate for creativity and innovation literatures, various frameworks for conceptualizing organizational structure are now addressed.

Perhaps the most commonly referenced characteristics of complex, large scale organizations are hierarchy of authority and division of labour (Blau & Schoenherr, 1971; Salaman, 1978; Thompson, 1961). These have persisted over the years as two broad identifying characteristics of organizations. Yet they are certainly not the only ones.

Robbins (1983) presented a list of "a dozen or so of the more popular variables used to define structural dimensions" (p. 45) of organizations. He noted that some dimensions were defined differently by various theorists. Robbins' list included: administrative component, autonomy, centralization, complexity, delegation of authority, differentiation, formalization, integration, professionalization, span of control, specialization, standardization, and vertical span (p. 45-47).

Describing organizations or bureaucracies on the

basis of dimensions or characteristics was first attempted by Max Weber (1946). His list of dimensions of bureaucracy can be summarized as:

1. Rules and procedures.
2. Specialization and division of labour.
3. Hierarchy of authority.
4. Technically qualified personnel.
5. Position and incumbent are separate.
6. Impersonality.
7. Written communication and reports (Daft, 1983, p. 126).

To study differences in the degree of bureaucratization among organizational subunits, Hall (1962; 1963) refined Weber's listing slightly into six dimensions. He observed that there was substantial agreement on the Weberian characteristics of bureaucracy among major theorists. Hall's research demonstrated that different segments or departments within an organization could vary on the degree to which they were characterized by these dimensions of bureaucracy.

As could have been expected, research then moved beyond examining organizations as separate cases, and began comparing organizations one to another along certain dimensions. In the early 1960's studies of

this nature began to appear (Scott, 1975).

The work of Hage (1965) followed this influence. He theorized that certain structural characteristics of organizations were means to certain organizational ends. He developed a theory of organizations using an axiomatic format which consisted of seven propositions and 21 corollaries. At the base of his theory were four structural components which he considered to be means. These were: "complexity, . . . a measure of how many specialties are utilized, centralization, . . . a measure of how power is distributed, formalization, . . . a measure of how many rules are used, and stratification, . . . a measure of how rewards are distributed" (p. 292). He hypothesized that when organizations were compared, variation in means would be found to precipitate variation in ends.

A group of researchers in the Industrial Administration Research Unit at the University of Aston in Birmingham, England began to systematically examine dimensions of organizations using multivariate analysis (Pugh, Hickson, Hinings & Turner, 1968). From data gathered on 52 industrial and service firms in the British Midlands they defined and operationalized 64 component variables which comprised five primary dimensions of organization structure: (1)

specialization, (2) standardization, (3) formalization, (4) centralization, and (5) configuration. Using principle components analysis they factored out four basic dimensions of structure: structuring of activities, concentration of authority, line control of the workflow, and relative size of supportive component.

Replications of these studies have verified the existence of these same dimensions (e.g., Child, 1972; Grinyer & Yasai-Ardekaine, 1980). In subsequent research only the two structural variables--Structuring of activities and Concentration of authority--tended to be used (e.g., Inkson, Pugh & Hickson, 1970). Pugh et al. (1968) emphasized that the existence of a dimensional approach made it possible to do comparative analysis of such factors as employee interaction and behaviour "since the effect of structural aspects of the organization can be controlled" (p. 89). In addition, the Aston group advanced their model to enable "typing" organizations according to structural characteristics, and thus, comparisons of organizations, one to another, could be made.

In their study of 53 U.S. Employment Security Agencies, Blau and Schoenherr (1971) examined a number of organizational variables such as size,

specialization, division of labour, automation, educational requirements, shape of the pyramid (i.e., number of levels and divisions, sections per division, and span of control), clerical ratio, supervisory ratio, staff ratio, and decentralization.

In 1973, Heydebrand attempted an elaborate first inventory aimed at "systematic, quantitative-comparative analysis of large-scale, complex formal organization" (p. 1). He clustered variables used in comparative analysis of organizations into four major ones: organizational environment and autonomy; complexity of goal and task structure; internal structural differentiation; and organizational coordination and control.

Zey-Ferrell (1979) in her text on organizational theory identified five organizational components which she considered determinants of other organizational dimensions. Her five categories were: environmental dimensions, contextual dimensions, process dimensions, structural dimensions, and performance dimensions. "The structural dimensions are: Centralization of power (hierarchy of control and department power); complexity (horizontal differentiation, vertical differentiation, and spatial differentiation); formalization and standardization of rules and procedures and

communication" (p. 10).

What is clear from this selective review of the past 35 years in organizational research is that organizations can be described along various structural dimensions. Common to most of these structural taxonomies is an indication of specialization (i.e., variously referred to as division of labour or horizontal differentiation), formalization, standardization, centralization and a fifth category containing such aspects as span of control, vertical differentiation and line versus staff personnel involvement in work flow. Pugh et al. (1968) refer to this last category as configuration.

The framework put forward by Pugh et al. (1968) is here considered to be the best and most comprehensive for examining the impact of organizational structure on creativity because (a) it is representative of other structural frameworks, and (b) as will be discussed later, the separate dimensions can be readily related to the elements of creative organizations presented earlier.

The Effects of Technology on Organizational Structure

Once dimensions along which organizational structure could vary were established, it was possible to examine the extent to which the work processes

within organizations influenced structure. The present study was concerned with organizations wherein the main technology was creative production. Technology was defined in its broad sense as "the knowledge, tools, techniques, and actions used to transform inputs into outputs" (Daft, 1983, p. 159).

Greater uncertainty in technology generally leads to less structuring of the organization (Robey, 1982). Technology is only one of three factors considered to affect organizational structure. The other two are size and external environment (Child, 1977, 1975; Ford & Slocum, 1977; Pugh, Hickson & Hinings, 1969). As organizations get larger they tend to become more structured. This is because "larger organizations have greater problems with coordination, control and supervision" (Daft, 1983, p. 160), therefore, they gravitate toward greater formalization, standardization and decentralization in order to cope.

As the external environment becomes more complex, organizations become less structured. Environmental complexity is an indication of "the number of external elements that are relevant to an organization's operation. In a complex environment, a large number of diverse external elements will interact with and influence the organization" (p. 49). If these are

relatively unstable and change rapidly, the organization needs to adapt easily to stay in tune with the demands and opportunities in its environment.

Technology is considered to play less of a role in determining total organizational structure because size and environment are more pervasive. However, the smaller the organization the greater the impact of technology on structure (Daft, 1983). The organizations of interest in this study are usually smaller and depend on constant innovation. If any are very large, then size may work at cross-purposes with attempts to limit structure in favour of uncertain technology. Other factors that have some effects on organizational structure are company age (Pugh et al., 1969) and dependency (Inkson et al., 1970; Pugh et al., 1969).

According to Daft (1983), the research on technology has been conclusive and no new technology frameworks have been developed in recent years. Three contributions are key in his estimation: the work of Joan Woodward, the work of Charles Perrow, and the concept of interdependence (Thompson, 1967).

Woodward's (1965) research assessed the congruence between organizations' structure and their technology in manufacturing industries. She developed a three-

category classification of technology. Her first category, small-batch and unit production, is where creative production would be classified, as opposed to her other two categories of large-batch and mass production; and continuous-process production. Small-batch and unit production was characterized by one-of-a-kind, special-needs, custom work. It was not highly mechanized and relied heavily on the human operator. Woodward found that for small-batch production, the management system had to be organic -- "free-flowing, adaptive, with few procedures and less standardization" (Daft, 1983, p. 164).

When Woodward examined the congruence between technology and organizational structure, she "discovered that successful firms tended to be those that had complementary structures and technologies" (Daft, 1983, p. 165). Subsequent studies have verified these findings (Zwerman, 1970; Harvey, 1968).

Perrow's (1967) contribution to the understanding of technology was to identify that technology can be conceptualized as varying along two dimensions: variety and analyzability.

Variety referred to the "number of exceptions in the work . . . which is the frequency of unexpected and novel events that occur in the conversion process"

(Daft, 1983, p. 173). For example, repetitious tasks would be considered low on variety.

Analyzability referred to the manner in which the transformation or conversion process was accomplished. "When the conversion process is analyzable, the work can be reduced to mechanical steps, and participants can follow an objective, computational procedure to solve problems" (p. 174). When the conversion process is not analyzable,

> cause-effect relationships characterizing the conversion process are unclear. When problems arise, it is difficult to identify the correct solution. There is no store of techniques or procedures to tell a person exactly what to do. Employees rely on accumulated experience, intuition, and judgment. The final solution to a problem is often the result of wisdom and experience, and is not the result of standard procedures (p. 174).

Thus, for analyzable work algorithms exist, whereas heuristics must be used when work is not analyzable. When variety is high and analyzability is low, Perrow applied the term nonroutine to describe the technology. "Basic research, strategic planning, and other work that involves new projects and unexpected

problems are nonroutine" (p. 175).

Typically, "routine technologies are characterized by mechanistic structure and processes, and nonroutine technologies by organic structure and processes" (p. 176). "Well intentioned managers who impose a tight, mechanistic structure on nonroutine activities are working against the requirements of the technology" (p. 178).

Task interdependence refers to "the extent to which employees or departments depend upon each other to accomplish their tasks" (Daft, 1983, p. 182). The highest form of task interdependence is reciprocal--"the output of departments influences one another in reciprocal fashion" (p. 183). When tasks are reciprocally interdependent frequent communication and mutual adjustment must be allowed by the structure. Extensive planning and coordination must be facilitated. Creative work is reciprocally interdependent when more than one person is working on the same problem. The requirement for communication and information flow is high. Often reciprocally interdependent activities are grouped together to facilitate easy access to one another.

In conclusion, creative production is an example of small-batch and unit production, nonroutine

technology, with reciprocal interdependence. As a consequence, structures should be low on formalization, standardization and centralization. Employees require formal education and experience, and should have more power and discretion in decision making. Spans of control should be moderate to narrow to facilitate interaction around work-related problem solving. Communication activity and frequency will be high, typically horizontal, with information conveyed face to face, for example over the telephone or in group meetings. Coordination and control should occur via horizontal processes such as group meetings.

Organizational Structure and Creativity

The following presents and discusses four dimensions of organizational structure and their relation to creativity.

Specialization. "Specialization is concerned with the division of labour within the organization, the distribution of official duties among a number of positions" (Pugh et al., 1968, p. 72-73). An activity is considered to be specialized if it is "performed by someone with that function and no other" (p. 73). Functional specialization refers to the degree to which specialized functions exist. Role specialization refers to "the extent to which specialist roles exist

within each of the . . . functional specializations" (p. 73). A role is considered to exist if a "particular specialization is performed by one or more persons full time" (p. 73).

Thus, highly specialized organizations would have all available activities divided among functional specialists and would have many specialized roles within each. Unspecialized organizations would have all available activities performed by nonspecialists.

Specialization can also be conceptualized as horizontal differentiation. Generally speaking, in large organizations, work is either performed by highly trained specialists who, because of their professional background and training, have a relatively high degree of autonomy. Or, work is subdivided into minute detail so that unskilled workers can easily perform the separate tasks. The latter situation normally occurs where the technology of the enterprise lends itself to routinization and uniformity. The work in these latter settings becomes highly regularized and controlled, as for example, on an assembly line. When the number of specializations is high, or when the work is subdivided into diverse functions, the workplace is said to be more complex, i.e., highly differentiated horizontally. Such diversity requires more concerted effort at

communication and coordination of distinct activities.

When the workplace is highly professionalized, this coordination is normally encouraged via workers taking responsibility for lateral, collegial liaison and efforts at integration (Blau & Schoenherr, 1971). Less emphasis is placed on coordination by superordinates. When tasks are highly routinized, repetitive, and performed by unskilled workers the functions of coordination and integration are almost totally performed by a superordinate (Hall, 1982).

As previously discussed, creativity requires easy access to information and effective communication. The greater the number of specialties, the greater the probability of obstruction to information flow (Galbraith, 1982).

In skunkworks, there are few specializations. Having fewer specialities reduces diversity among workers who might otherwise "have different goal emphasis, time orientations and even a different work vocabulary" (Robbins, 1983, p. 48). With fewer specialties, less coordination is needed, potential conflict is reduced, as is the need for layers of vertical differentiation.

Therefore, it would seem that more creative organizations would have fewer specializations.

Standardization. "Standardization is the extent to which similar work activities [and procedures] are performed in a uniform manner" (Daft, 1983, p. 15). Standardization ensures predictability of action not only in a crisis but in everyday, routine activities. Highly standardized organizations provide a great deal of direction on how work is to be done and how, when and where reporting and information is to flow. Procedures for such activities as inspection, control, communication, recruitment and training, and marketing are performed in a highly uniform manner. If organizations that depend on the inventiveness and creativity of their employees were highly standardized, the freedom and information flow essential for creativity would be severely curtailed.

Some level of standardization is likely required to give meaning to and make sense of a highly uncertain environment, i.e., some level of order is required. But the creative person's need for order is much lower than usual (MacKinnon, 1962). Therefore, what most people would consider chaos, may be facilitative (Quinn, 1985). Need for order can be met through having regular employment, a place to work, colleagues and a regular pay cheque. Standardization concerns the procedures for work, and if these become too ordered

then there will likely be interference with creative performance.

In skunkworks, there can be little standardization --anything goes. However, this is not to say that certain customs, traditions, rituals, or even work methods do not emerge. All social groups develop some informal patterns of interaction (Bales, 1970; Sweeney & Allen, 1984). Even though these are different from standardized work procedures, and less detrimental for creativity, they still require a regular "shake-up" to keep people from getting too set in their ways (Stein, 1974).

Creative people also bring to the job some standard problem attack skills, heuristics, scientific methodology, and other procedures or styles which they have used consistently over the years (Amabile, 1983b). In addition. education and training impart standardized methods (Hall, 1982). As a consequence the creating person may already proceed via standardized work procedures. But these are internalized. They result in each individual approaching different problems in his or her own, established ways, rather than everyone being expected to approach problems all following the same pre-established procedures. Nevertheless, when an individual is restricted by his own, familiar and

usual, internalized problem attack skills, creativity will suffer (Stein, 1975). Many creativity training programs try to break people out of such "ruts".

It would seem, then, that the less standardized, in all respects, the more creative (provided that there is some baseline level of order for people to function).

Therefore, more creative organizations would likely be found to have less standardization.

Formalization. "Formalization denotes the extent to which rules, procedures, instructions, and communications are written" (Pugh et al., 1968, p. 75). Formalization is similar to standardization in that both contribute to uniformity of practice. However, the key difference is that formalization is concerned with the degree to which these work defining (or constraining) features are written down, for example, written role definitions, documents for passing information, and recording role performance. Formalization therefore achieves a higher level of standardization.

As with standardization, highly formalized organizations would curtail freedom of problem pursuit and applied methods, as well as flow of information. If procedures manuals exist and are to be followed, and

if formal channels of communication are prescribed and enforced than creativity has less chance of occurring or surviving. In skunkworks there are no organization charts, no job descriptions, no procedure manuals, and no formal communication channels. Instead there are "webs of voluntary, mutual responsibility" (Kidder, 1981).

It would seem, then, that those organizations that are more creative would be found to be less formalized.

Centralization. "Centralization has to do with the locus of authority to make decisions affecting the organization" (Pugh et al., 1968, p. 76). Factors affecting centralization include (1) the level in the hierarchy at which particular decisions are made, and (2) rules which limit the discretion of subordinates to make certain decisions. Authority to make decisions can be delegated to lower levels of the hierarchy but if the decisions to be made are predetermined by policy and procedures, then little decentralization actually exists (Hall, 1982).

People required to be creative should be allowed to decide which problems they will work on and how they will pursue them. They should also have authority to decide who they will talk to about what, and to generally have within their authority the broadest

possible access to information without requiring approvals from others for such access.

Decentralization is often associated with a high level of specialization (Robbins, 1983). The explanation is that the more specialized the work, the harder it is for superordinates to know what is going on, and therefore, decisions must be made by the subordinates. But creative organizations need to be both non-specialized and decentralized to facilitate the broadest range of communication and freedom.

Therefore, it would seem that those organizations that are more creative would be less centralized.

To summarize this section, it would seem that those organizations which are more creative would have fewer specializations, less standardization, less formalization, and less centralization.

Overview of Job Structure

This section will identify the dimensions along which job structure can be described.

The earliest literature on characteristics of jobs was the work on division of labour by Adam Smith. Smith (1908) advocated dividing work into small pieces, with each man performing only one piece, in order to maximize efficiency. The division of work into minute segments was developed much further when Frederick

Taylor (1947) applied engineering principles to the design of jobs. His scientific management movement started a concentration of effort to find the perfect fit between worker and work. It was the epitome of rational management. The solution to productivity problems seemed to lie in the application of mechanical engineering principles to the motions of human beings. "The dominant view of job design was that specialization increased efficiency. Jobs, therefore, should be specialized, simplified, standardized, and routinized" (Robbins, 1983, p. 247). All that was required was the worker's cooperation, which would ultimately mean his willingness to move like a machine. But, as with most human related endeavours, efficiency was not so simplistically attained.

"Extreme specialization had its drawbacks--being increasingly associated with boring tasks, unchallenging work, and employee alienation" (Robbins, 1983, p. 248). With the human relations movement in management of the 1940's and 1950's, attention shifted to the human needs of employees. The interest in and study of work concentrated on seeking alternatives "to make work less routine and more meaningful" (p. 248) which has had its ultimate realization in the movement known as Quality of Work Life (QWL).

Most of the QWL literature is concerned with employee satisfaction as the dependent variable, and indices of dissatisfaction which cost the employer such as absenteeism, turnover, tardiness, and sabotage. The focus is on what characteristics of work make jobs meaningful, rather than what characteristics of work make jobs "do-able." Not only does job design require attention to making work meaningful, but especially for creative work, some job characteristics determine whether the work is even do-able. For example, autonomy is associated with meaningful work (Robey, 1982), but, as discussed earlier, it is also essential to enable creative work. It is possible that the main focus should not be, how to design jobs to satisfy creative workers, hoping that creative performance will follow; but rather, how should work be designed to enable creative performance. Satisfaction should follow.

Scientific management was concerned with kinetics, movements, manual operations and the application of physical movements to the completion of tasks. The grounding discipline was mechanical engineering--the relation of force and matter in machines. When jobs involve mental operations, mechanical engineering principles have no application. Psychology is the

preferred discipline to guide the study of job design for cognitive work. By exploring the nature of the creative thinking process and creative performance, it should be possible to prescribe environmental conditions (specifically in this section, job conditions) that enable, hopefully facilitate, and even epitomize this kind of work.

Strategies or options considered most often for creating meaningful work are job rotation, job enlargement, job enrichment, integrated work groups, autonomous work groups, and quality circles (Robbins, 1983). It is noteworthy that skunkworks, discussed earlier, embody, to a large extent, all of these options.

From this very brief overview of work design a number of characteristics of jobs have been suggested such as specialization, simplification, standardization, routinization and meaningfulness. Robey (1982) suggests that there are three specific task-design variables: autonomy--the degree of discretion one has in task performance; variety--how many activities a persoh performs; and specificity--how those activities should be performed (p. 283). Hackman and Oldham (1980), reviewing the literature on job characteristics theories, found the following kinds

of attributes had been studied: "the amount of variety in the work, the level of employee autonomy in performing the work, the amount of interaction required in carrying out task activities (and the number of opportunities for optional interaction), the level of knowledge and skill required, and the amount of responsibility entrusted to the job holder" (p. 59).

Robbins (1983) states that "the most complete and best known framework for guiding job redesign efforts is the job characteristics model" (p. 250) developed by Richard Hackman and Greg Oldham. "According to the model, any job can be described in terms of five core job dimensions" (Robbins, p. 250): skill variety, task identity, task significance, autonomy and feedback from job. When the extent of each dimension is high, jobs are considered to be enriched, and thus, low in structure.

Hackman and Oldham (1980) defined these job characteristics as follows:

"Skill variety: The degree to which a job requires a variety of different activities in carrying out the work, involving the use of a number of different skills and talents of the person" (p. 78).

"Task identity: The degree to which a job requires completion of a 'whole' and identifiable piece

of work, that is, doing a job from beginning to end with a visible outcome" (p. 78).

"Task significance: The degree to which the job has a substantial impact on the lives of other people, whether those people are in the immediate organization or in the world at large" (p. 79).

"Autonomy: The degree to which the job provides substantial freedom, independence, and discretion to the individual in scheduling the work and in determining the procedures to be used in carrying it out" (p. 79).

"Job feedback: The degree to which carrying out the work activities required by the job provides the individual with direct and clear information about the effectiveness of his or her performance" (p. 80).

Hackman and Oldham were interested in identifying "reasonably objective, measurable, challenging properties of the work itself" (p. 77) that would foster certain psychological states, "and through them, enhance internal work motivation" (p. 77). The critical psychological states which they claimed needed to be present for strong internal work motivation to develop and persist were: Experienced meaningfulness of the work; Experienced responsibility for outcomes of the work; and Knowledge of the actual results of the

work activities. Skill variety, task identity and task significance were considered to contribute to experienced meaningfulness of the work; autonomy was considered to contribute to experienced responsibility; and feedback from the job was considered to contribute to knowledge of results.

By assessing the extent to which these five job dimensions were present, Hackman and Oldham maintained it was possible to determine the motivating potential of jobs. When measuring job dimensions, Hackman and Oldham advised that individual growth need strength and job satisfaction needed to be treated as control variables. Others (e.g., Payne & Pugh, 1983; Schnake, 1983) have also reported that job satisfaction must be controlled when employees are providing descriptive ratings of work characteristics.

Individual growth need strength was defined as "the readiness of individuals to respond to 'enriched' jobs (Hackman & Oldham, 1975, p. 159) and may influence "how positively an employee will respond to a job with objectively high motivating potential" (p. 163). Job satisfaction referred to the degree of satisfaction the employee felt overall toward the job as well as to several facets of it. Job satisfaction was found to be positively related to job dimensions.

Kohn and Schooler (1982) classified job conditions in their research on the effect of working conditions on men's personalities. They referred to these conditions as structural imperatives of the job. "They are 'structural' in two senses: they are built into the structure of the job, and they are functions of the job's location in the structures of the economy and the society. These job conditions are 'imperatives' in that they define the occupational realities that every worker must face" (p. 1259). Their model consisted of 14 job conditions clustered into four areas: "[1] man's place in the organizational structure, [2] his opportunities for occupational self-direction, [3] the principle job pressures to which he is subjected, and [4] the principle extrinsic risks and rewards built into his job" (p. 1259).

Their job condition of occupational self-direction referred to "the use of initiative, thought and independent judgment" (p. 1259), and was facilitated or inhibited by substantive complexity, closeness of supervision and routinization. They defined substantive complexity as "the degree to which performance of the work requires thought and independent judgment" (p. 1261).

They considered closeness of supervision to limit

one's opportunities for occupational self-direction. They considered highly routinized jobs to be repetitive and predictable, and as such "restrict possibilities for exercising initiative, thought and judgment, while jobs with a variety of unpredictable tasks may facilitate or even require self-direction" (p. 1261). Of all the job conditions, they found occupational self-direction to be the most pervasive, and in particular, self-directed work led to ideational flexibility. Kohn and Schooler's research strongly supported the need for autonomy in cognitive work.

For purposes of examining job structures that support creativity, Hackman and Oldham's (1980) five job characteristics will be used.

Job Structure and Creativity

The following is a presentation and discussion of job structure characteristics and their relation to creativity.

Skill variety. In Hackman and Oldham's (1980) job characteristics theory, skill variety was essential for experienced meaningfulness, and subsequently for internal work motivation. They stated that for work to be meaningful it must involve a variety of tasks which required a variety of skills.

Creative performance requires a variety of

knowledge and information. Highly creative people tend to have a broad range of skills and abilities. Because a variety of skills are often involved, skill variety and creative performance would likely correlate highly in any measure of job structures within successful, creative organizations.

In summary, it is likely that jobs in more creative organizations will involve a variety of skills.

Task identity. Task identity, as defined by Hackman and Oldham (1980), is the antithesis of specialization and the subdivision of jobs into small pieces. "When workers have an intact task, such as providing a complete unit of service or putting together an entire product, they tend to see that task as more meaningful than is the case when they are responsible for only a small part of the job" (p. 78). Even though task identity results in work being more meaningful, is it essential as an enabler of creative work?

Segmentalization of work into many parts requires greater emphasis on integration and coordination to put the output from each segment together into a marketable whole. This taxes communication and information flow. Ideally, there should be as little subdivision as

possible in order to maximize information flow.

Task identity is also related to the motivator Big, important opportunities. For people to feel motivated by the opportunity to work on a major project, they need to experience their contribution as more than a small segmentalized component.

Consequently, it is possible that jobs in more creative organizations would be rated higher on task identity.

Task significance. This variable relates more directly to the motivator Big, important opportunities. From Hackman and Oldham's (1980) point of view, significance is dependent upon "substantial impact on the physical or psychological well-being of the other people, [for example] . . . someone else's happiness, health, or safety" (p. 79). For creative work, significance is broader. If the work is seen in a major way to contribute to the success of the organization, or to the advancement of knowledge or technology in a particular domain, then the work will be internally motivating. It is in this broader sense that work needs to be significant.

It would seem likely that jobs in more creative organizations would be rated higher on task significance (broadly speaking) than in less creative

organizations.

Autonomy. The characteristic of creative climates that autonomy relates to is freedom. Because freedom plays such a crucial role in creativity, autonomy is probably more significant than any other job structure characteristic in creating a climate for creativity.

Task uncertainty is key to the degree of autonomy that is required. "Task uncertainty refers to the lack of patterning [or organization] among the elements necessary to execute a task" (p. 82). Lack of patterning can be thought of as variability, and subsequent lack of predictability. Patterning or structure may be missing in either the input elements to a task or in the operations performed on the inputs.

"Tasks which are highly certain permit greater specialization, standardization, and less dependence on the discretion of the person performing the job. [Thus, autonomy can be, and often is, low.] Uncertain tasks must be designed to provide greater flexibility because fewer task elements can be completely prescribed" (Robey, 1982, p. 283). The inputs and the transformation process involved in creativity are very uncertain, therefore a high level of autonomy is essential.

It would seem likely, then, that jobs in more

creative organizations would be rated higher on autonomy than those in less creative organizations.

Feedback. Hackman and Oldham (1980) emphasized feedback "directly from the job, as when a television repairman turns on the set and finds that it works (or doesn't work)" (p. 80). Feedback from other sources such as peers, supervisors or customers is seen as secondary in importance, even though it does still contribute to the "overall knowledge an employee has of the results of his or her work" (p. 80).

Feedback is of critical importance to the climate for creativity. Because feedback is information and creativity is a problem solving process, feedback is crucial to completing the loop. Feedback assists lots of tries, lots of starts and lots of fails. Accurate feedback is a key link in "increasing the failure rate" in an enterprise.

It would seem likely that jobs in more creative organizations would be rated more highly on feedback (about the efficacy of each potential solution or pathway tried) than less creative organizations.

In summary, jobs in more creative organizations would likely be rated highly on all five of Hackman and Oldham's (1980) job dimensions.

Summary

Creativity was defined as bringing something new into existence. Invention was found to imply bringing something useful into existence. Innovation was defined as bringing something into use, and involved both creativity and inventiveness. Creativity in industrial settings was considered to be manifested in the early stages of innovation, i.e., idea generation or initiation.

A model identifying the essential elements of creative and innovative organizations was presented that consisted of: Resources, Culture, Motivators, and Enablers.

Pugh et al.'s (1969) framework for organizational structure was considered to be the best and most comprehensive for examining the impact of organizational structure on creative performance. Their two main structural factors were Structuring of activities and Concentration of authority.

Given the nature of creative production and the influence of technology on organizational structure, certain structural contingencies should be evident to accommodate this type of work. With respect to organizational structure, it would seem likely that those organizations which are more creative would be:

1. Less specialized
2. Less standardized
3. Less centralized
4. Less formalized

Overall, they would likely be low on structuring of activities and low on concentration of authority.

Hackman and Oldham's (1980) five job dimensions were considered the best known and most complete for researching job structure. With respect to job structure, it would seem that jobs in more creative organizations would have:

1. high task variety
2. high task identity
3. high task significance
4. high autonomy
5. high feedback

Overall, they would likely have a high motivating potential score (i.e., low job structure) as determined by the combination of Hackman and Oldham's five job dimensions.

Research Questions

The dimensions of organizational structure that this study focused on were structuring of activities and concentration of authority. The concept of job structure was taken as Hackman and Oldham's motivating

potential score. Because this was a preliminary study, it simply examined whether there were relationships between these structural variables and indicators of performance in companies that were engaged in inventing or creating new products.

The specific research questions, then, were as follows. In a sample of companies engaged in invention and creation:

1. Was there a relationship between organizational structure and creative performance?
2. Was there a relationship between job structure and creative performance?
3. Was there a relationship between organizational structure and job structure?
4. Did these relationships exist even when characteristics of the workers and elements of creative organizations were controlled?
5. Were organizations that were better at creative performance lower on organizational structure?
6. Were organizations that were better at creative performance lower on job structure?
7. Did these differences exist even when characteristics of the workers and elements of creative organizations were controlled?

Chapter Three

Methodology

Sample

To address the research questions in this study a sample of firms engaged in inventing and creating new products was required. In Saskatchewan, the Department of Science and Technology maintained a list of companies which they referred to as high-technology firms. The Department used the term "high-technology" interchangeably with "advanced-technology" and used them both to refer to "products or processes which [were] at the leading edge of innovation, providing new solutions for old problems" (Saskatchewan Science and Technology, 1987, p. 145). The Department was enthusiastic about the study being conducted in Saskatchewan and offered to facilitate access to the firms and provided assistance in the form of telephone and office facilities. It was likely that if the companies on the list were screened, a sufficient number would be found that were engaged in inventing and creating new products. Given that this was a preliminary study, it was appropriate to use such a list as a convenient source from which to identify a sample of firms. Sampling from an existing list and researching organizations to which access has been

granted or facilitated by some managing or governing body are the two sampling strategies relied on by most organizational researchers (Bedeian, 1984).

The Saskatchewan Department of Science and Technology had been attempting to encourage the industrial development of advanced technology and reported the following record:

> The advanced technology industrial sector increased from 39 active companies in 1982 to over 160 companies in early 1987.
>
> Sales increased from $81 million in 1982 to over $400 million in 1986. . . .
>
> Direct employment increased from 1.7 thousand in 1982 to nearly 3 thousand in 1986 . . . (p. 151).

Surveying firms from the same province provided for control of some external environmental factors that impinge on companies such as geographical proximity to ports, markets and suppliers, provision of government assistance, impact of government legislation and policy, general economic conditions, access to financial resources, and labour market fluctuations.

Size. Many organizations that engage in invention and creation are small. For example, a study of 124 software companies in the National Capital Region in and around Ottawa found 55% had 15 or fewer employees and only four percent had more than 150 employees (The Research Centre, 1985). Statistics Canada (1985)

reported that 45% of companies engaged in research and development in Canada had 49 or fewer employees. In researching the effects of structure in small organizations it seemed prudent to determine a minimum size to ensure that properties of organization, i.e., structuring of activities and concentration of authority, would be measurable. Establishing a minimum size is not unusual. For example, in Johne's (1984) study into the relationship between loose versus tight organization structures and leaders versus followers in product innovation, he included only firms of 100 employees or more "to enable investigation of interdepartmental interaction which is difficult to study in small firms because often there is little or no functional specialization" (p. 58).

Robbins (1983) defined an organization as "the planned coordination of the collective activities of two or more people who, functioning on a relatively continuous basis and through division of labor and a hierarchy of authority, seek to achieve a common goal or set of goals" (p. 5). But others (e.g., Blau & Schoenherr, 1971; Katz & Kahn, 1978) imply that more than two people are required for the study of organizations or social systems. "The development of organizational structures can be conceptualized as

differentiation and integration. . . . Some minimal increase in numbers . . . is necessary to provide a safe margin for such separation of functions and their institutionalization (Katz & Kahn, 1978, p. 104).

Group theory provided some guidance on the question of a minimum size. Watson and Johnson (1972) reported that although triads certainly meet the definition of a group, they are considered "unstable because of the tendency toward coalition-formation" (p. 83). Hare (1976) concluded that five was the optimum size for a small discussion group "since members are generally less satisfied with smaller or larger groups" (p. 231). Ohlsen (1970) reported four as the minimum number for group counselling or group therapy.

Kephart (1950) illustrated how the number of potential relationships between individuals, between subgroups, and between an individual and a subgroup increases much more rapidly than size. With only two group members the number of relationships is one; with three group members it is six; with four group members it becomes 25; and with five members it is 90. A significant break point in number of potential relationships occurs between group size three and four.

Two and three were judged too small for variance in differentiation and integration to occur, and

although five would have been appropriate, it was difficult to justify eliminating those organizations with only four employees given that the number of potential relationships within a group of four seemed sufficient to ensure variance in organizational dynamics. Taking organization and group theory into account, only those firms having four or more employees were included in the present study. Using four as the minimum size was not meant to imply that organizations of this size were considered the same as much larger organizations consisting of 200, 300, or more employees. In fact as will be discussed, size was predicted to be an intervening variable and was statistically controlled.

Idea generators. Of those firms with four or more employees, only those employing at least one (i.e., one in addition to the owner or chief executive officer) as an idea generator were included. If the owner or chief executive officer (CEO) was the only idea generator then the workers' experience of the organization was likely as an assembly, manufacturing, or distribution firm rather than a creative one.

Screening. The firms on the list provided by the Department of Science and Technology were screened by telephone to confirm that at least four people were

employed, and to identify those firms which were currently engaged in invention, creation, design or development of new products, new services, new solutions or any form of scientific research. Companies responding in the affirmative were further screened to determine whether one or more people were employed as idea generators. The term "idea generator" was used to refer to any employee who was expected to be currently inventing, creating, designing or developing new products, services or solutions, or conducting scientific research.

The CEO of each company meeting the above criteria was asked to agree to: (1) participate in the research; (2) fill out a questionnaire; (3) submit to a follow-up interview; and (4) allow those employed as idea generators to each fill out a questionnaire. An attempt was made to have 10 idea generators, as identified by the CEO, from each company respond. Where more than 10 were employed, a random sampling procedure was used to select 10. In some cases where there were fewer than 10 idea generators, and not all were asked to fill out a questionnaire, selection by the CEO was based on availability, proximity and workload.

Dependent Variables

Creative performance was defined as the level of success of a company at inventing and creating new products as rated by the CEO. This definition was operationalized to include inventing, creating, designing or developing new products, new services, new solutions or any form of scientific research.

Creative performance had both a qualitative and a quantitative dimension. Data on both dimensions were gathered by using a questionnaire entitled Criteria for Success of Organizations at Creativity and Invention, completed by the CEO of each company. The qualitative dimension was measured by seven items which were taken from an instrument developed by Cooper (1984) to assess how well "firms' new product programmes fare" (p. 13).

Cooper determined that prior to his research "there existed no universally accepted single criterion for gauging and comparing the results of firms' new product programmes" (p. 13). One important goal of his research into new product development was to identify "useful gauges of new product performance, so that we could measure and, more important, conceptualise, what was meant by the term, 'good performance'" (p. 13). Through reviewing the literature on the performance of research and development departments, and interviewing

managers, Cooper identified seven "gauges of performance":

-the percentage of current company sales made up by new products introduced over the last five years;

-the success, failure and "kill" rates (per cent) of products developed in the last five years (two variables--since success, fail and kill rates add to 100 percent, only two variables, not three, are measured);

-the extent to which the new product programme met its performance objectives over the last five years;

-the importance of the programme in generating sales and profits for the company;

-the extent to which profits derived from new products exceeded the costs of the new product programme;

-the successfulness of the programme relative to competitors;

-the successfulness of the programme--a global rating (p. 13-14).

For the first two, respondents were asked to provide percentages. The last five were measured using zero-to-ten anchored scales.

Cooper extensively pretested his questionnaire and personally interviewed pretest respondents following completion of the test questionnaire (1979). He then administered the instrument to a random sample of 170 industrial product firms from Ontario and Quebec drawn from a government listing of firms active in new product development.

Cooper had originally intended to combine all seven measures to yield a single index of performance (1986) but found some companies fared well on some measures and poorly on others. Some gauges were correlated but "there was by no means total consistency; indeed, the Cronbach's alpha . . . was actually negative (-.31)" (1986, p. 18). He used factor analysis to identify three underlying performance dimensions which he used to better explain firms' new product results. These dimensions were:

-Program impact, which captures the impact or importance of the program on the corporation, particularly on company sales and profits.

-Success rate, which depicts the "track record" of the products the firm develops; i.e., the success, fail and kill rates.

-Relative performance, which portrays the overall performance of the program relative to objectives,

versus competitors, in terms of profits versus costs, and in a global sense (1986, p. 18).

Cooper (1984) found his performance criteria to discriminate among firms by company size, industry and industry characteristics such as technology level, growth rate, and technological maturity.

The care taken in the development of these items and the fact that they were originally validated in a sample of firms that were engaged in new product development satisfied the investigator that they possessed adequate content and a degree of construct validity for use in the present study.

In order to decrease the probability of finding several underlying dimensions of performance in the present study, and to focus on the creative quality of inventions and creations at the idea generation stage (i.e., the initiation stage of product development), only Cooper's items relating to the underlying performance dimensions of success rate and relative performance were used (see Items 1 to 5, 9 and 21, Part I. Criteria for Success of Organizations at Creativity and Invention in Appendix A).

Further validity was demonstrated in the current study by a correlation coefficient of $r = .86$ ($p = .000$) between the scores on Cooper's items and the scores on

the Canada Awards for Business Excellence items (to be discussed next). This provided evidence of a high degree of concurrence between CEOs' opinions of the success of their companies at inventing and creating new products, and their ratings of their new products' commercial and technical merits. That scores on all qualitative measures of performance did not correlate significantly ($r = -.06$; $p = .71$) with the quantitative measure of performance provided a degree of discriminant validity.

In addition to Cooper's items, the qualitative measure was also made up of eleven scaled items asking for ratings of the extent to which recent creations and inventions demonstrated scientific, technical and commercial merit. These items were taken from the government of Canada's Department of Industry, Science and Technology, Canada Awards for Business Excellence Program criteria for appraising the category of Invention. These criteria were originally developed in 1984 by a reputable consulting firm commissioned by the Government of Canada. They have been modified and used each year since then by a panel of expert judges drawn from industry, and research or invention-service agencies across Canada, and assembled to select award winners for outstanding achievement in invention. Each

year new judges have been appointed. As a result, since 1984, 16 managers have found the criteria to be valid or have modified them until they were (Gadbois, 1988).

The care in developing, and ongoing use of, these criteria for the purpose of evaluating the merits of inventions and creations in industrial settings across Canada satisfied the investigator as to their validity for use in the current study. The eleven Canada Awards for Business Excellence criteria were incorporated into a questionnaire format using scaled items. (See Items 10 to 20, Part I. Criteria for Success of Organizations at Creativity and Invention in Appendix A.)

All scaled items utilized a zero to 10 Likert scale. The zero end was labeled "Not at all" and the 10 end was labeled "Extremely high." In between there were no labels but only the numbers from one to nine evenly spaced along the scale.

Principle components analysis with varimax rotation revealed that all qualitative items loaded on one factor making it appropriate to combine the items into one dimension, labeled Creative Quality, for the present study. The exceptions were items 5, 10, 15 and 20 which were subsequently dropped to improve the instrument's internal consistency. The mean of all 14

items (18 minus 4) described above was taken as the qualitative measure of creative performance.

The quantitative dimension was measured by items devised by the investigator. (See items 6, 7 and 8, Part I. Criteria for Success of Organizations at Creativity and Invention in Appendix A). These items asked for the number of company creations or inventions in the past two years, whether they had been long-, mid- or short-term, and how many people had worked as idea generators on these creations and inventions. During follow-up CEO interviews the investigator verified their responses.

Because a greater number of short-term than long-term inventions could be created in a given amount of time, a weighting for the length of term was utilized. The following formula was used to calculate the quantitative measure, i.e., the number of inventions per idea generator per year, weighted for long-term.

$$\frac{([(LT \times 12) + (MT \times 4) + (ST)]/1200) \times HOWMANY/IDEAGENS}{2 \text{ years}}$$

Where LT= Percent of inventions that were long-term (i.e., taking months or years)

MT= Percent of inventions that were mid-term (i.e., taking weeks or months)

ST= Percent of inventions that were short-term (i.e., taking days or weeks)

HOWMANY= The number of new products created or invented in the past two years

IDEAGENS= The number of idea generators who worked on these inventions

Although further validation could possibly have strengthened the interpretability of the results of the Criteria for Success of Organizations at Invention and Creativity instrument for measuring the dependent variables in this sample, the restrictions of time and particularly the CEOs' reluctance to devote more time to this study, the high cost of collecting data, and the focus of the research (on initial exploration, not prediction) resulted in finding the above indications of validity to be sufficient.

Independent Variables

Organizational Structure

Pugh et al.'s (1969) concept of organizational structure was adopted for this study. Numerous replication, reappraisal and application studies have reaffirmed the reliability and validity of the Aston measures in delineating the structural dimensions of various enterprises. Inkson et al. (1970), for example, using two independent dimensions of structure to test for accuracy of representation found correlations ranging from .91 to .97.

A questionnaire to assess organizational structure was devised from Inkson et al.'s (1970) abbreviated form of the interview guide used by Pugh et al. (1968)

(see Part II., Appendix A). Inkson et al. (1970) concluded that their abbreviated version retained the technical soundness of the original questionnaire. Many studies have used and validated the abbreviated form (e.g., Newberry, 1971; Heron, 1972; Sackney, 1976; Goodwin, 1978). Although written instructions had to be added to make a functional questionnaire and the format changed to enable respondents to check off their answers, Inkson et al.'s items were not altered other than to change the words "organization" to "company" and "welfare" to "benefits". Only the Structuring of activities and Concentration of authority scales were administered.

Structuring of activities was the sum of Functional Specialization and Formalization.

Functional Specialization was measured as the number of functions from a set list of 16 that were specialized in each company (see Section A., Part II., Appendix A). A function was defined as specialized when at least one person performed that function and no other.

Formalization was a measure of the existence and extent of application or distribution of certain role-defining documents from a set list (see Section B., Part II., Appendix A). Scores on Formalization could

range from zero to 19.

Concentration of authority was measured as the number of decisions from a set list of 23 that had to be made at or above the CEO's level of authority (see Section C., Part II., Appendix A).

Organizational structure, thus, was a two-dimensional variable and was defined as the extent to which mechanisms existed at the organizational level of each firm to pre-determine how activities were to be conducted, and to concentrate authority at or above the top of the firm.

The CEO of each company completed the questionnaire entitled Organizational Structure: Short Form and his responses were confirmed by an in-person or telephone interview.

Job Structure

Job structure was measured using Hackman and Oldham's (1975) Job Diagnostic Survey (see Sections One and Two, Part I., Appendix B). Accordingly, job structure was defined as the extent to which the idea generator jobs in each company provided skill variety, task identity, task significance, autonomy and feedback, as rated by the incumbent. The development of the Job Diagnostic Survey, including evidence for reliability and construct validity, is reported in

Hackman and Oldham (1974 & 1975). National norms for 6,930 employees working in 876 different jobs in 56 organizations are provided in Hackman and Oldham (1980).

Using Hackman and Oldham's formula, which appears below, scores on the five job characteristics were combined to arrive at a Motivating Potential Score (MPS) for each respondent's job. A high MPS was defined as low job structure, and vice versa.

(SKILLVAR + TASKIDNT + TASKSIGN)/3 x AUTONOMY x FDBKJOB = MPS

Where SKILLVAR = Skill variety

TASKIDNT = Task identity

TASKSIGN = Task significance

AUTONOMY = Autonomy

FDBKJOB = Feedback from the work itself.

When more than one questionnaire was returned from a company, the mean MPS was used as the company's job structure score. Use of the mean was recommended by Hackman and Oldham (1975) as the appropriate method for aggregating scores of individual job incumbents.

Covariates of the Dependent Variables

Elements of Creative Organizations

The review of the literature indicated that many factors, beyond organizational structure and job structure, affect success at invention and creativity.

Some of these are internal to the company and are of primary concern to this study. As defined and discussed in the literature review chapter, the internal environmental factors taken into account here are resources, culture, motivators, and enablers. Data on these variables were collected using a questionnaire prepared by the investigator and completed by each idea generator. The questionnaire used Likert scales which ranged from zero to 10. The zero end was labeled "Not at all" or for some items, "Never." The 10 end was labeled "Totally and absolutely" or for some items, "Always." In between there were no labels but only the numbers from one to nine evenly spaced along the scale. The questionnaire was entitled Elements of Creative Organizations (Part II., Appendix B).

To measure the adequacy of resources the following items were used. Respondents were instructed to use as a frame of reference their opinion of the optimum level needed to ensure top notch creativity and invention, and then rate the items.

1. Money

    a. The amount of money for creativity and invention is adequate?

    b. Special funds are available for unforeseen projects?

2. Material

   a. Facilities and equipment are adequate?

   b. The quality and quantity of supplies and materials are sufficient?

3. Data

   a. The company has enough of the right data and information?

4. Human Resources

   a. The company provides enough human resources?

   b. The human resources possess the right qualities (i.e., technical skills and knowledge, conducive work style, creative bent, and motivation)?

To measure the extent of culture for creativity, the following items were used.

1. To what extent is there an atmosphere around here of truly valuing and prizing creativity and invention?

2. To what extent are people expected to be creative and inventive?

3. To what extent does this company have a reputation for creativity and invention?

To measure motivators, the following were used.

1. To what extent are people given the opportunity to do work that is prestigious and important?

2. To what extent do people work on projects or products that have a direct bearing on the company's overall success?

3. To what extent is creativity and invention properly rewarded?

4. To what extent do people get proper recognition for the work they do?

To measure enablers, the following were used.

1. Communication/Information Flow

   a. To what extent are the creators and inventors uninformed about such things as changes in company priorities, user requirements, new product thrusts, etc.? In other words, to what extent does the Nobody-ever-tells-me-anything factor exist around here?

   b. To what extent do the creators and inventors get enough information about how well they and their projects are doing?

   c. To what extent do the creators and inventors have full and easy access to include or consult with whomever on whatever information they need in the course of their work?

   d. To what extent do seminars or events occur to exchange ideas (on requirements, problems, opportunities, successes, failures, products, etc.) and to bring together people with similar interests within the company and between companies or other agencies?

   e. To what extent are continuing education, visitations, reading, professional conferences and the like, facilitated?

2. Freedom

   a. To what extent are the creators and inventors free to choose which problems and products they work on?

   b. To what extent are the creators and inventors free to apply methods and pursue the solutions to problems and the creation of new products entirely in their own manner?

3. Skunkworks

   a. To what extent does creativity and invention take place in "skunkworks", i.e., free flowing, intense, basement-like atmospheres where idea people work together and anything goes?

   b. To what extent are these "skunkworks" separated

from the rest of the organization?

4. Lots of Starts, Tries, and Fails

   a. To what extent are the creators and the inventors free to fail without fear of punishment?

   b. To what extent are the creators and inventors always trying out new ideas and starting new projects?

5. Sponsorship and Orchestration

   a. To what extent does a "sponsor" emerge to promote, encourage and facilitate the creation of new products?

   b. To what extent are the creators and inventors buffered from the regular administrative requirements and procedures of the company?

   c. To what extent does somebody with enough power in the company make sure that new products get a chance?

The score on elements of creative organizations for each idea generator was calculated as the mean response on all 28 items. The mean of the idea generators' scores in each company was used as the company score.

The mean was used as the method of aggregating scores because it is considered the best approximation of "the typical, average or usual way people in a setting describe it" (Schneider cited in James, 1982, p. 221). Recent challenges to the use of the mean (particularly in climate research) without prior demonstration of homogeneity of variance (e.g., James, 1982; Joyce & Slocum, 1984) are limited to

"interpreting agreement estimates based on aggregates (means) as applying to agreement among individuals" (James, 1982, p. 228). Such studies find that collectives of shared perceptions do "not necessarily overlap formal organizational units, divisions, or work groups" (Joyce & Slocum, 1984, p. 722). In the present study the need to maintain the integrity of company boundaries and to obtain a single score to represent each company on each variable necessitated using the mean. Demonstrating shared perception or level of agreement of perceptions was beyond the scope of this study.

Characteristics of the Workers

As indicated in the review of the literature, certain qualities of a company's human resources may affect success at creativity and invention. Demographic data were collected from the idea generators in 9 areas: sex, age, experience, tenure, amount of training in creative expression, amount of ongoing training in one's field of specialization, whether one is educated in the field in which one is currently working, number of years of education, and the highest degree obtained. Questions to collect this data from idea generators were prepared by the investigator and included at the end of the Job

Characteristics Survey (see Items 1 to 7, Section Six, Part II., Appendix B).

In addition to the above, a measure of personal creative ability was administered to all idea generators. This consisted of the question "List below as many uses as you can think of for a brick. (Please limit yourself to 10 minutes)." This type of question is found in the Minnesota Tests of Creative Thinking (Yamamoto, 1964) used to measure creative ability. The item was embedded in the Job Characteristics Survey (see Item 8, Section Six, Part II., Appendix B). From participant responses three scores were calculated; fluency, i.e., the number of uses listed; flexibility, i.e., the number of shifts from one class of use to another; and originality, i.e., the number of unusual uses, measured as those that were listed less than 5% of the time in the entire sample. An overall score for creative ability was computed as the sum of fluency, flexibility and originality.

Within each company, individual scores were aggregated to obtain a company score for each characteristic. Idea-generator sex, and whether education was in the field of current employment were dichotomous variables. They were aggregated as the percent of male idea generators in each company, and

the percent of idea generators in each company with education in the field of current employment, respectively. The values for the highest degree obtained were aggregated as the percent of idea generators in each company with graduate degrees. Creative ability was aggregated as the mean creativity score for each company.

Because data on age, experience, tenure, training in creativity, ongoing training, and years of education had been gathered using discrete categories, the midpoint of each category was assigned as the category's value to all respondents choosing that category. The means of the idea generators' assigned values were used as the companies' scores for these variables.

Covariates of the Independent Variables

Covariates of Organizational Structure

As discussed in the review of the literature, the following are likely to restrict the freedom of organizational structure to vary: size, i.e., the number of employees; age, i.e., the number of years in business; and dependency, i.e., whether a company is a separate entity or part of a larger, parent organization. Data on these variables were collected from each CEO. The size and age of each company was

obtained during the follow-up telephone contact. Dependency was determined by the following item on the Organizational Structure: Short Form questionnaire (see Section C, Part II., Appendix A):

"Check which of the following applies to you;

[ ] 1. My company (i.e., the part of which I am the head) is part of a larger company.

[ ] 2. My company (i.e., the part of which I am the head) is an independent business, not part of any larger company."

Covariates of Job Structure

As indicated in the review of the literature, affective reactions to the job and individual growth need strength are known to influence ratings of job structure (Motivating Potential Score). These two covariates were measured using Hackman and Oldham's (1975) Job Diagnostic Survey.

The affective-reactions-to-the-job score, referred to as job satisfaction, for idea generators was the mean of 15 items addressing facet (i.e., pay, security, growth opportunities, co-workers, and supervision) and global satisfaction (see Section Three, Part I., Appendix B).

The individual growth need strength score, i.e., "the readiness of individuals to respond to 'enriched' jobs" (Hackman & Oldham, 1975, p. 159), was derived

from a combination of two sections (Section Four and Five, Part I., Appendix B). The first section contained items addressing the extent to which certain of Herzberg's motivating factors were valued. In the second section respondents indicated their relative preference for pairs of hypothetical jobs. Jobs with characteristics relevant to growth needs satisfaction were paired with jobs which had the potential for satisfying some other needs.

Following Hackman and Oldham's methodology, company growth need strength scores and company job satisfaction scores were calculated by averaging the idea generators' scores in each company.

Data Collection

Data were collected using a mail questionnaire approach (Oppenheim, 1966). Two questionnaire booklets were prepared, one for CEOs and one for idea generators. The CEOs' booklet contained a covering letter; the questionnaires: Criteria For Success Of Organizations At Creativity And Invention, and Organizational Structure: Short Form; and a self-addressed return envelope. The idea generators' booklet contained a covering letter; the questionnaires: Job Characteristics Survey, and Elements of Creative Organizations; and a self-

addressed return envelope.

The Department of Science and Technology, Government of Saskatchewan in Regina provided a list of all high-technology firms in the province with four or more employees. The Deputy Minister sent each CEO a letter introducing the investigator and asking for cooperation and willingness to participate in this research. (See Appendix C for the text of the letter.) The next week, by telephone the investigator began screening the companies and soliciting a commitment directly from each CEO to participate. Questionnaire booklets were mailed to the selected CEOs, including those to be distributed by him to the idea generators.

For the idea generators, a variation on a self-administered questionnaire approach was utilized (Oppenheim, 1966). The CEO in each firm identified the idea generators, secured their agreement to participate, distributed the questionnaire booklets, collected the completed ones in sealed envelopes, and mailed them to the investigator. Introductory comments printed on the cover of the idea generators' questionnaire booklet provided a further explanation of the purpose of the research (see Appendix B). Follow-up telephone calls were made four weeks after distribution and again at six weeks to remind

nonresponding CEOs. Also, CEOs managing nonresponding idea generators were urged to prompt them. The unusually long lapse-time before following up was in deference to CEOs who were very busy and requested considerable time before returning questionnaires. During follow-up telephone calls, meeting dates were arranged to confirm responses to the CEOs' questionnaires and pick up late questionnaires. All participants were assured of confidentiality and anonymity.

Statistical Analysis

Questionnaire responses were entered into a data file for idea generators and a data file for CEOs. SPSS^{x} (SPSS Inc., 1986) was used for data analysis. Idea generators' scores aggregated across companies were combined with the CEO data file to create a company data file.

Reliability coefficients (Cronbach's Alpha) were computed for measures of creative performance, organizational structure, job structure, elements of creative organizations, creative ability, growth need strength, and job satisfaction. Frequency distributions with descriptive statistics such as mean, median, and standard deviation, as well as crosstabulations were computed to facilitate an initial

examination of the data.

Pearson correlation was used to initially test for a relationship between each dimension of creative performance and organizational structure (Research Question 1), creative performance and job structure (Research Question 2), and job structure and organizational structure (Research Question 3). Multiple correlation was used as a subsequent test for Research Questions 1 and 3 because organizational structure was two-dimensional. Whenever multiple correlation was used, the stepwise method was run first. This was to determine, statistically rather than theoretically, which of the independent variables of interest contributed most to the variance in the dependent variable. Then, the forced entry (or hierarchical) method was used to determine, depending on the particular research question, what contribution certain independent variables made to the variance, either on their own in some cases, or after others had been taken into account. Given that this was a preliminary, exploratory study, using stepwise regression first, ensured that statistically important relationships would not be overlooked when examining the strength of theoretical ones.

Pearson correlations were calculated to confirm

covariates of the independent and dependent variables.

Partial correlation and multiple correlation were used to test for the existence of the relationships in Research Questions 1 to 3 while controlling for covariates of the dependent variables (Research Question 4).

Crosstabulation and analysis of variance were used to test whether organizations that were better at creative performance were lower on organizational structure and lower on job structure (Research Questions 5 and 6, respectively). Analysis of covariance was used to test whether these differences still existed after controlling for elements of the environment and characteristics of the workers (Research Question 7).

To re-test these research questions while controlling for covariates of the independent variables, partial correlation, multiple correlation, and analysis of covariance were used.

The results of all of these analyses are presented in the following chapter.

Chapter Four

Presentation of Results

Data Collection

The list provided by the Department of Science and Technology contained 95 firms. Most of the telephone screening was completed in one week. A few firms were contacted the following week. Fifty-six firms met the selection criteria as outlined in Chapter Three, and agreed initially to participate. Table 1 shows the reasons for screening out firms and reasons given for declining.

Fifty-six CEO questionnaire booklets and 227 idea generator questionnaire booklets were distributed in the last week of May, 1987. Two firms declined to participate after receiving the questionnaires, and two others during the telephone follow-up because of time constraints. Thus, 52 CEOs and 203 idea generators could potentially respond.

Completed questionnaires began arriving by mail the week after initial distribution. With the exception of one late arrival in August, by the end of July, all questionnaires from those participating in the study had been returned.

Table 1

Companies Screened Out or Declining

Number	Reason for being screened out
8	No longer in business
3	Fewer than four employees
15	Not inventing or creating
11	No idea generators employed
37	

Number	Reason for declining
1	No time to participate
1	Fear of participation being misconstrued as benefiting from a government subsidy
2	

Sample

Thirty-nine firms participated in the study. This represented a 75% return rate for CEOs. The firms ranged in size from four to 390 employees. The mean size was 41, the median was 13.5, and the mode was four. On average, they had been in business for 7.5 years, with the range being one to 25 years, the median being 5.75, and the mode being four years. Table 2 provides the list of firms.

Twenty firms were located in Saskatoon, 15 in Regina, and four outside of these two major centres, one each in Kindersley, North Battleford, Birch Hills, and Estevan. The companies were grouped into six product categories: electronics, biotechnology, foods, plastics, computer software, and manufacturing. Electronics was the largest category accounting for 43.6% of the firms, and within it there were a variety of applications: agriculture, aerospace, instrumentation, robotics, measuring devices, computerized equipment, telecommunications, and computers. Computer software was the next largest category, representing 33.3% of all firms.

One hundred and seventeen idea generators participated from the 39 companies. This represented a 57.6% return rate. The number of idea generators

Table 2

Companies Participating in the Study

Name	COID	SIZE	COAGE	DPNDCY	Sector	Idea Generators
Company A	901	20	13	0	1	2
Company B	903	390	15	1	1	8
Company C	904	10	7	0	1	0
Company D	905	8	4	0	1	1
Company E	906	28	12	0	1	2
Company F	907	14	7	0	1	3
Company G	908	16	6	0	1	1
Company H	909	28	7	0	1	5
Company I	911	7	4	0	3	3
Company J	912	35	14	0	4	6
Company K	914	17	7	0	3	4
Company L	916	22	1	1	1	6
Company M	917	15	3	0	5	0
Company N	918	162	13	0	1	5
Company O	919	45	21	1	1	2
Company P	920	4	4	0	1	1
Company Q	922	130	12	0	4	1
Company R	923	4	6	0	1	2
Company S	924	30	25	0	1	2
Company T	925	12	4	1	3	3
Company U	926	7	3	0	1	1
Company V	931	11	1	0	1	2
Company W	932	7	5	0	2	4
Company X	934	4	6	0	2	0
Company Y	936	8	4	0	2	2
Company Z	938	9	2	0	2	4
Company AA	940	4	8	0	2	1
Company BB	942	9	1	0	6	2
Company CC	943	11	5	0	1	1
Company DD	945	14	3	0	2	3
Company EE	946	8	7	1	3	6
Company FF	947	10	4	0	2	1
Company GG	948	13	13	0	2	4
Company HH	950	60	6	1	2	8
Company II	951	90	12	0	2	7
Company JJ	953	32	4	0	2	1
Company KK	954	6	3	0	3	1
Company LL	955	14	3	0	2	2
Company MM	956	260	17	0	2	10

COID = Company identification number.
SIZE = Number of employees.
COAGE = Number of years in business as of July 1, 1987.
DPNDCY: 0 = Independent company; 1 = Part of larger company.
SECTOR: 1 = Electronics; 2 = Computer Software; 3 = Biotechnology;
4 = Foods; 5 = Plastics; 6 = Manufacturing.

responding from any one company ranged from 0 to 10, with the mean being 3, the median being 2.72 and the mode being 1. The column headed "Idea Generators" in Table 2 shows the number that participated from each company.

Dependent Variables

Creative Performance

Creative performance was a two-dimensional variable made up of a quantitative and a qualitative measure. Data were gathered for both dimensions by having the CEO of each company complete the Criteria For Success Of Organizations At Creativity And Invention questionnaire. After checking the reliability of the questionnaire, four items were dropped: I5, I10, I15, and I20. The remaining 14 items had a Cronbach's Alpha of .93, more than satisfactory to assure its consistency as a measure. Principle Components analysis confirmed that I10 and I20 loaded on single-item factors and warranted being dropped for lack of definition. Item I5 loaded on three factors, none above .53. Item I15 had a loading of .72 on Factor 3, the item with the highest loading on that factor and it did not load on any other factor, suggesting that I15 was measuring something different from Factor 1 on which all other items loaded.

The mean score for the qualitative measure of creative performance (CRETQUAL) was 7.6 and the standard deviation was 1.47 with a range of 3.4 to 9.5 on a zero to 10 scale. (See items 1 to 5, 9 and 21 on Part I. Criteria for Success of Organizations at Creativity and Invention, in Appendix A). Low scores indicated that the CEO's ratings of company success at inventing and creating new products were low. High scores indicated the opposite. The distribution for creative quality was severely, negatively skewed.

The mean score for the quantitative measure of creative performance (PRODQUAN) was .92 and the standard deviation was 1.08. (See items 6 to 8 on Part I. Criteria for Success of Organizations at Creativity and Invention, in Appendix A). Scores ranged from .09 to 5.00 and represented the number of inventions or creations per idea generator per year, weighted for long term. The distribution for creative quantity was severely, positively skewed.

Independent Variables

Organizational Structure

Organizational structure was a two-dimensional variable made up of Structuring of activities (STRUCACT) and Concentration of authority (CONCAUTH). Data were gathered on both dimensions by having the CEO

of each company complete the Organizational Structure: Short Form questionnaire. Structuring of activities was the sum of Specialization and Formalization. Cronbach's Alpha for Specialization was .85 and for Formalization was .82--acceptable for an initial study. They were as good as or better than scalability coefficients reported by Inkson et al. (1970) (.71 for structuring of activities) and Pugh et al. (1968) (.76 for Specialization; .67 to .74 for measures of Formalization).

The scores for structuring of activities were mildly positively skewed with a mean of 11.7, median of 9.5, standard deviation of 8.2 and a range of 0 to 34 (derived from items in Section A, designed to assess Specialization, and items in Section B, designed to assess Formalization, Part II., Appendix A). The largest possible score was 35, although this was almost reached by one company, 97.4% (i.e., all other companies) scored 24 or less. Low scores indicated low structuring of activities. High scores indicated high structuring of activities.

Scores on concentration of authority ranged from 3 to 23 with a mean of 13.7 and a standard deviation of 5.6 (derived from items in Section C, Part II., Appendix A). The maximum possible score was 23. Low

scores meant few decisions must be made at or above the CEO's authority. High scores meant many decisions required the CEO's (or above) authority. Cronbach's Alpha for concentration of authority was .87, an acceptable level. Inkson et al. (1970) and Pugh et al. (1968) reported scalability coefficients in the .74 to .83 range. The distribution was not skewed but many cases fell in the tails.

Job Structure

Job structure was measured by computing Hackman and Oldham's Motivating Potential Score (MPS) from the idea generators' responses to the Job Characteristics Survey. Reliability for MPS was .82 (Cronbach's Alpha), a satisfactory level. Hackman and Oldham (1975) reported internal consistency reliabilities ranging from .59 to .71 for the individual job dimensions.

The mean for all idea generators' MPS scores (derived from items in Sections One and Two, Part I., Appendix B) was 180.3 with a standard deviation of 61.4 and a range from 18.7 to 337.6. Low scores meant that jobs were rated low on skill variety, task identity, task significance, autonomy and feedback, i.e., they were high in structure. High scores represented "rich" jobs in terms of skill variety, task

identity, task significance, autonomy, and feedback and were therefore low on job structure. The distribution was slightly negatively skewed. Within each firm, the idea generators' individual scores were averaged to obtain a job structure score for each company (CMPSHO). The mean CMPSHO score was 186 with a standard deviation of 43.8. Scores ranged from 77.6 to 311.1. Again, low scores meant high job structure.

Covariates of the Dependent Variables

Characteristics of the Workers

Ten characteristics of the workers were expected to covary with the companies' creative performance. These were sex, age, experience, tenure, amount of training in creativity, amount of ongoing training in the field of specialization, whether previous education was in the field in which one now worked, number of years of education, the highest degree obtained, and creative ability (CREATVTY). Cronbach's Alpha for CREATVTY was .94.

Data were collected from individual idea generators (see items 1 to 8, Section Six, Part II., Appendix B) and aggregated to obtain a company score on each characteristic. Before aggregation, the data indicated that 88% of the idea generators were male. The most common age category was 30 to 34 years, while

58.2% were between 25 and 34 years of age. The most common experience categories were 5 to 10 years (30.8%) and 3 to 5 years (29.9%). Thirty percent of the idea generators had been with their current employers for 1 to 2 years; another 26.5% had been with their current employers for 3 to 5 years. The majority of idea generators had had no training in creativity (52.1%) and less than one month's ongoing training in their field (66.4%). Eighty-four percent reported that they had been educated in the field in which they now worked. The most common amount of education was 14 to 16 years (46.6%) and the most common educational credential was a bachelors degree (53.7%). Twenty one percent had graduate degrees. Scores on creative ability ranged from 3 to 73 with a mean of 25.4. (Low scores meant low creative ability. High scores meant the opposite.)

After aggregation the average percentage of male idea generators employed in these companies was 92% with no company employing less than 50% males, and 66.7% of the companies employing 100% males. The average age in these companies ranged from 22 to 41 years with the mean being 30.8 years. Average experience ranged from .875 to 15 years, with a mean of 5.8. For tenure, the company means ranged from .25 to

12.5 years, and the grand mean was 3.3 years. The company means for years of training in creativity ranged from 0 to 1.5 years, with a grand mean of .18 years. For ongoing training in one's field the means ranged from 0 to 1.3 years, with a grand mean of .25 years. The percentage of idea generators in each company educated in their current field of employment ranged from 0 to 100%, with a mean of 84.4%; 56.4% of companies employed idea generators who were all educated in their current field of employment. Average years of education ranged from 8 to 20.25, with a mean of 16 years. The percentage of idea generators with graduate degrees in each company ranged from 0 to 100%, with a mean of 20%. The mean creative ability scores in these companies ranged from 3 to 40.5, with a grand mean of 23.0. The aggregation across companies did not appear to distort or otherwise misrepresent idea-generator data.

Elements of Creative Organizations

Elements of creative organizations was measured as the mean of idea-generator responses to the Elements of Creative Organizations questionnaire. When all 28 items were included, the reliability was .89 (Cronbach's Alpha). The reliability was improved to .91 by dropping items 15, 22, 23, and 27. This was a more

than satisfactory level of reliability for a first use of this questionnaire.

The scores on the Elements of Creative Organizations questionnaire for idea generators (see items 1 to 28, Part II., Appendix B) ranged from 2.5 to 9.1 with a mean of 5.9 and a standard deviation of 1.3. The maximum possible score was 10. The distribution was slightly negatively skewed. A low score meant the idea generator rated his place of work low on the extent of resources, culture, motivators, and enablers for creativity. High scores meant the opposite.

Within each company, idea generators' scores were averaged to obtain a company score. The mean company score was 6.0 with a standard deviation of 1.1. Company scores ranged from 3.3 to 8.5. A low score meant that the average idea-generator rating of the resources, culture, motivators, and enablers for creativity in that company was low. High scores meant the opposite. The distribution was more negatively skewed.

Covariates of the Independent Variables

Covariates of Organizational Structure

Company size, the number of years in business, and dependency were expected to covary with organizational structure, and possibly confound the relationship

between organizational structure and the dependent variables.

Size was severely positively skewed. Even though size ranged from 4 to 390 employees with a mean of 41 and a standard deviation of 77.2, the median of 13.5 was far more representative of the sample.

Company age was also positively skewed but not to the extent size was. Company age ranged from 0.9 to 25 years with a mean of 7.5 and a standard deviation of 5.7.

Independent firms out numbered dependent by more than 5 to 1. Thirty-two of the firms in this sample were locally owned and operated. Dependency was very severely skewed--82% of the cases were in one category.

Departing from the sequence of tables, Table 6 shows that size (SIZE), company age (COAGE) and dependency (DPNDCY) were all significantly correlated with structuring of activities (STRUCACT) and concentration of authority (CONCAUTH). The same table shows that none of them correlated significantly with creative performance (CRETQUAL nor PRODQUAN).

Returning to the sequence of tables, Tables 3, 4, and 5 show the means and standard deviations for all dependent and independent variables when size, company age and dependency were partitioned into

categories. Size was partitioned into four groups: small was defined as four to 10 employees; medium was defined as 10 to 20 employees; large was defined as 20 to 60 employees; and very large was defined as more than 60 employees. Company age was partitioned into three groups: young was defined as less than four years; middle was defined as four to ten years; and old was defined as more than ten years. Dependency was partitioned into two groups: independent and dependent.

Table 3 shows that there was a tendency for structuring of activities to increase proportionally to size, and for concentration of authority and job structure (CMPSHO) to decrease proportionally to size. Except for large and very large companies, which were reversed, there was some tendency for product quantity to decrease in proportion to size.

Table 4 shows that other than structuring of activities increasing in proportion to company age, the middle-aged firms had the highest means.

Table 5 shows that product quantity, concentration of authority and job structure were higher for independent than dependent companies. The reverse was observed for structuring of activities.

Covariates of Job Structure

Job satisfaction was calculated from the idea

Table 3

Breakdown of Dependent and Independent Variables by Size

		Mean	SD	N
CRETQUAL				
	Small	7.74	1.27	15
	Medium	7.63	1.40	11
	Large	7.81	1.88	8
	Very Large	6.86	1.62	5
	All Companies	7.61	1.46	39
PRODQUAN				
	Small	1.32	1.44	15
	Medium	.82	.70	11
	Large	.32	.35	8
	Very Large	.54	.33	5
	All Companies	.88	1.04	39
STRUCACT				
	Small	7.07	6.45	15
	Medium	9.55	5.65	11
	Large	15.88	5.96	8
	Very Large	22.80	7.09	5
	All Companies	11.59	8.08	39
CONCAUTH				
	Small	16.93	4.83	15
	Medium	15.18	3.40	11
	Large	9.25	4.77	8
	Very Large	8.00	3.16	5
	All Companies	13.72	5.49	39
CMPSHO				
	Small	201.91	49.53	13
	Medium	189.85	30.10	10
	Large	174.40	38.14	8
	Very Large	156.64	51.14	5
	Idea Gen's	180.26	61.39	116
	All Companies	186.16	43.77	36

Table 4

Breakdown of the Dependent and Independent Variables by Company Age

		Mean	SD	N
CRETQUAL				
	Young	7.08	1.68	16
	Middle	8.37	.88	12
	Old	7.55	1.35	11
All	Companies	7.61	1.46	39
PRODQUAN				
	Young	.84	1.12	16
	Middle	1.32	1.24	12
	Old	.44	.28	11
All	Companies	.88	1.04	39
STRUCACT				
	Young	9.13	6.70	16
	Middle	10.08	7.83	12
	Old	16.82	8.40	11
All	Companies	11.59	8.08	39
CONCAUTH				
	Young	15.13	4.76	16
	Middle	16.08	5.27	12
	Old	9.09	4.06	11
All	Companies	13.72	5.49	39
CMPSHO				
	Young	190.84	42.39	15
	Middle	198.05	41.95	10
	Old	168.97	45.91	11
	Idea Gen's	180.26	61.39	116
All	Companies	186.16	43.77	36

Table 5

Breakdown of the Dependent and Independent Variables by Dependency

		Mean	SD	N
CRETQUAL				
	Independent	7.64	1.48	33
	Dependent	7.42	1.42	6
All	Companies	7.61	1.46	39
PRODQUAN				
	Independent	.92	1.12	33
	Dependent	.61	.44	6
All	Companies	.88	1.04	39
STRUCACT				
	Independent	9.91	7.55	33
	Dependent	20.83	3.13	6
All	Companies	11.59	8.08	39
CONCAUTH				
	Independent	14.61	5.17	33
	Dependent	8.83	4.88	6
All	Companies	13.72	5.49	39
CMPSHO				
	Independent	192.85	40.00	30
	Dependent	152.69	50.19	6
	Idea Gen's	180.26	61.39	116
All	Companies	186.16	43.77	36

generators' responses to Section Three of the Job Characteristics Survey questionnaire (see items in Section Three, Part I., Appendix B). Growth need strength was calculated from the idea generators' responses to Sections Four and Five (see items in Sections Four and Five, Part I., Appendix B). Growth need strength had an alpha of .73 which was improved to .74 by dropping items I503 and I511. This was a marginally acceptable level of reliability. Hackman and Oldham (1975) reported internal consistency reliability ranging from .71 to .88.

Overall idea-generator job satisfaction (OVRSAT) was created as a combination of facet and global satisfaction. Cronbach's Alpha for OVRSAT was .8[illegible]. This was satisfactory, and exceeded those reported by Hackman and Oldham (1975) which range from .56 to .84 for the separate facets of satisfaction.

For growth need strength, the Idea Generators' scores ranged from 3.3 to 6.4 on a one to seven scale with a mean of 5.3 and a standard deviation of .62. The distribution was negatively skewed. Low scores meant low need for enriched jobs. High scores meant high need for enriched jobs.

For overall job satisfaction, the Idea Generators' scores ranged from 2.9 to 6.7 on a one to seven scale

with a mean of 5.2 and standard deviation of .84. The distribution was negatively skewed. Low scores indicated low idea-generator satisfaction with pay, security, growth opportunities, co-workers, supervisors, and the job in general. High scores indicated high satisfaction.

Growth need strength and overall job satisfaction were each aggregated by averaging the idea generators' ratings in each company to obtain company scores. Company growth need strength ranged from 3.7 to 5.9 with a mean of 5.2 and a standard deviation of .52. The distribution was negatively skewed. Low scores indicated low average scores on growth need strength within the company. Company overall job satisfaction ranged from 3.5 to 6.6 with a mean of 5.3 and a standard deviation of .67. The distribution was negatively skewed. Low scores indicated low average scores on job satisfaction within the company.

Table 6 (page 124) shows that growth need strength aggregated across companies (CCMBGNS2) did not correlate with job structure (CMPSHO), therefore it was dropped from any further consideration as a covariate. Overall job satisfaction aggregated across companies (COVRSAT) was correlated with job structure ($r = .57$; $p = .000$) confirming it as a covariate. Overall job

satisfaction aggregated across companies did not correlate significantly with creative performance.

Missing Data

Some variables had missing data. Where data were provided as CEO ratings, an N of 39 was possible; 38 was achieved for creative quality, structuring of activities, and concentration of authority; 35 was achieved for product quantity. Where data were provided by aggregating employee ratings, an N of 36 was possible. This was achieved for all variables except percentage of male idea generators (N = 35), highest degree (N = 34), and creative ability (N = 32).

There was no CEO questionnaire returned for the company that was missing a creative quality score. The responses from the one idea generator who replied from that company were used to calculate the missing creative quality score. Values for structuring of activities and concentration of authority for this company were estimated by examining values on other variables that they correlated with, namely size and elements of creative organizations, to determine whether the estimates should be above or below each variable's mean and by how much. The value for product quantity for this company was calculated using the idea generator's ratings.

For the other three companies missing a product quantity score, CEO ratings were available on all but one of the variables needed for the equation used to calculate product quantity. To arrive at an estimate of the missing variable, a combination of the following was used: (a) mean idea generator value on the missing variable, (b) estimation of the value based on data the CEO had provided, and (c) prior knowledge to establish reasonable bounds for the missing value. The value for each missing variable in the equation was thus estimated and a product quantity score calculated.

The missing value for percentage of male idea generators was estimated from general knowledge of the company and the trend for most idea generators to be male. The two missing values for highest degree were estimated by examining years of education to determine the likelihood of the idea generator having a graduate degree or not. Scores on company creative ability were estimated for four cases by examining what company creative ability tended to correlate with (i.e., years of education, job satisfaction, and job structure) to estimate whether the scores should be above or below the mean and by how much.

The above methods for estimating missing data were drawn from Tabachnick and Fidell's (1983) advice that

"it is probably better to guess at the value than to insert the mean routinely" (p.71). Their advice for guessing is to use a combination of "certain demographic or classification attributes for the case" (p. 71) along with prior knowledge to ascertain whether the value is likely to be above or below the mean and by how much.

Following the addition of missing data, a comparison of the intercorrelation matrix of all variables, before and after including missing data estimates, was made. The correlation coefficients did not change appreciably. The analyses for Research Questions 1 to 4 were run twice, with missing data estimates and without. The results were basically unchanged. It was decided to use the data with missing data estimates included. Table 11 in Appendix D shows the descriptive statistics for all variables after adding missing data estimates.

Outliers

By examining z scores, univariate outliers were observed for years of education (1 outlier), ongoing training (1 outlier), training in creativity (2 outliers), tenure (1 outlier), percentage of idea generators with related education (1 outlier), company age (1 outlier), and product quantity (2 outliers).

Size had one outlying case with a z = 4.58.

No multivariate outliers were found among the independent variables. Some Mahalanobis' distances were large but the corresponding Cook's distances were not large and not significant.

Assumptions, Normality, Linearity and Homoscedasticity

Skewness

Creative quality and percentage of male idea generators were severely negatively skewed. Product quantity, size, company age, dependency and training in creativity were severely positively skewed. Percentage of idea generators with related education and percentage with graduate degrees were moderately positively skewed. Company growth need strength was moderately negatively skewed.

An initial run with standard multiple regression was performed to examine the shape of the scatterplots of residuals against predicted dependent variable scores. Scatterplots confirmed skewness for both dependent variables and some suggestion of heteroscedasticity for product quantity, i.e., the assumption that the standard deviations of errors of prediction were approximately equal at all predicted product quantity levels may have been violated. The normal probability plots of residuals in which the

expected normal values were plotted against their actual sizes revealed greater deviation from normality for product quantity than for creative quality.

Intercorrelations

Table 6 shows intercorrelations for all dependent variables, independent variables, and covariates after adding missing data estimates.

Research Question 1

Research Question 1 read "Was there a relationship between organizational structure and creative performance?" Table 6 shows that the correlation between product quantity (PRODQUAN) and structuring of activities (STRUCACT) was significant ($r = -.42$; $p = .008$), as well as product quantity and concentration of authority (CONCAUTH) ($r = .39$; $p = .015$). Creative quality (CRETQUAL) was not significantly related with either organizational structure variable.

When stepwise multiple regression was run for product quantity as the dependent variable and both structuring of activities and concentration of authority as the independent variables, structuring of activities was selected at the first step ($R = .42$; Signif $F = .008$) and concentration of authority did not add significantly after structuring of activities had been taken into account. Research Question 1 was

Table 6

Intercorrelations for all Variables

	CRETQUAL	PRODQUAN	STRUCACT	CONCAUTH	SIZE	COAGE	DPNDCY	CMPSHO	CCNBGHS2	COVRSAT
PRODQUAN	-.06	1.00								
STRUCACT	-.23	-.42*	1.00							
CONCAUTH	.13	.39#	-.54**	1.00						
SIZE	-.27	-.14	.60**	-.39#	1.00					
COAGE	-.01	-.19	.42*	-.50*	.49*	1.00				
DPNDCY	-.06	-.11	.49*	-.39#	.28	.12	1.00			
CMPSHO	.28	.26	-.45*	.28	-.43*	-.27	-.35#	1.00		
CCNBGHS2	.38#	-.02	.15	-.04	.09	.09	.24	.05	1.00	
COVRSAT	.04	.22	-.40#	.22	-.29	-.23	-.19	.57**	.02	1.00
CELMENT2	.32	.35#	-.56**	.40#	-.39#	-.31	-.42#	.75**	-.05	.54**
CSEX	-.01	-.08	-.22	-.15	-.11	-.08	-.09	-.09	-.31	-.11
CAGE	.06	-.47*	.17	-.10	-.05	.01	-.04	-.10	-.20	.08
CEXPRNCE	.04	-.27	.31	-.40#	.15	.38#	.08	-.23	.03	-.07
CTENURE	-.08	-.12	.42#	-.50*	.33#	.51*	.09	-.22	-.03	-.18
CTENCRET	.08	-.22	.06	-.00	-.15	.02	.06	-.15	.08	-.13
CONGOTEN	.03	-.15	.24	-.26	.29	.32	.27	-.38#	.10	-.34#
CRELED	-.18	.01	.17	-.19	.07	.24	.14	.05	-.17	-.10
CYRSEDOC	.04	-.35#	.29	-.18	.13	.02	.03	-.39#	-.09	-.31
CHYSTED	.01	-.28	.09	.10	-.08	.02	-.04	.02	.09	-.14
CCREATVY	.11	-.35#	.36#	-.11	.36#	.28	.08	-.41#	.10	-.49*

	CELMENT2	CSEX	CAGE	CEXPRNCE	CTENURE	CTENCRET	CONGOTEN	CRELED	CYRSEDOC	CHYSTED
CSEX	-.09	1.00								
CAGE	-.14	-.04	1.00							
CEXPRNCE	-.27	.05	.59**	1.00						
CTENURE	-.41#	.09	.16	.64**	1.00					
CTENCRET	-.29	.01	.07	.19	-.03	1.00				
CONGOTEN	-.46*	.06	-.11	.15	.09	.77**	1.00			
CRELED	.03	.11	-.30	.09	.21	.26	.29	1.00		
CYRSEDOC	-.32	-.14	.38#	.21	.12	.15	.12	.09	1.00	
CHYSTED	-.15	-.12	.32	.23	.10	.26	.04	.13	.51*	1.00
CCREATVY	-.20	-.11	.11	.05	-.07	.00	.16	.08	.53*	.28

Significance level at .05; * Significance level at .01; ** Significance level at .001

answered in the affirmative for product quantity and structuring of activities.

Using forced entry multiple regression, there was a significant relationship when both organizational structure variables were entered in a block with product quantity as the dependent variable ($R = .46$; Signif $F = .014$).

When each of size, company age and dependency was partialled out of the relationship between product quantity and organizational structure, a significant relationship remained for all first-, second- and third-order partials. The third-order partial for product quantity with structuring of activities was $r = -.42$; $p = .011$; $df = 34$, and for product quantity with concentration of authority was $r = .34$; $p = .045$; $df = 34$.

Using stepwise multiple regression with product quantity as the dependent variable and structuring of activities, concentration of authority, size, company age, and dependency as the independent variables, structuring of activities was the only variable selected. None of the others added significantly to the variance in product quantity after structuring of activities had been taken into account.

Research Question 2

Research Question 2 read "Was there a relationship between job structure and creative performance?" There was no significant relationship between either creative performance variable and job structure (CMPSHO). Looking back at Table 6, the correlation coefficients can be seen. The research question was answered in the negative. When the effects of overall job satisfaction (COVRSAT) were partialled out, there was still no significant relationship.

Research Question 3

Research Question 3 read "Was there a relationship between organizational structure and job structure?" Table 6 shows that there was a significant relationship between job structure (CMPSHO) and structuring of activities (STRUCACT) ($r = -.45$; $p = .006$). The relationship was confirmed using stepwise multiple regression analysis. Concentration of authority did not add significantly to the regression after structuring of activities was taken into account, and was not significantly correlated on its own.

When job satisfaction, size, company age and dependency were partialled out, the correlation between job structure and structuring of activities was no longer significant ($r = -.03$; $p = .446$; $df = 30$).

When structuring of activities was entered as the dependent variable in the stepwise multiple regression, with job structure, size, company age, and dependency as the independent variables, size was selected at the first step (R = .60; Signif F = .000) and dependency was selected at the second step (R = .69; R^2 Change = .12; Signif F Change = .011; Signif F (Model) = .000). None of the other variables contributed to the variance in structuring of activities after size and dependency were taken into account.

When job structure was the dependent variable in the stepwise regression with job satisfaction and structuring of activities as the independent variables, job satisfaction was selected at the first step (R = .57; Signif F = .000) and structuring of activities did not add significantly after that.

The research question was answered in the affirmative for a relationship between job structure and structuring of activities, but the relationship did not last when covariates of the independent variables were taken into account.

Research Question 4

Research Question 4 read "Did these relationships exist even when characteristics of the workers and elements of creative organizations were controlled?"

One of the dependent variables, creative quality, did not correlate significantly with elements of creative organizations nor any of the characteristics of the workers. Therefore, none of these were controlled as covariates of creative quality. Also, as already reported, no relationship existed between creative quality and organizational structure, creative quality and job structure, nor product quantity and job structure, therefore these relationships were not retested while controlling for covariates.

Elements of creative organizations did correlate significantly with product quantity, and was thus a legitimate covariate ($r = .35$; $p = .035$) (from Table 6). Of the 10 characteristics of the workers, three covaried with product quantity: idea-generator age ($r = -.47$; $p = .004$), years of education ($r = -.35$; $p = .039$), and creative ability ($r = -.35$; $p = .037$). One of these was significantly correlated with an independent variable: creative ability was correlated with structuring of activities ($r = .36$; $p = .031$). Elements of creative organizations correlated with both independent variables: with structuring of activities ($r = -.56$; $p = .000$); and concentration of authority ($r = .40$; $p = .016$).

Using stepwise regression with product quantity as

the dependent variable and structuring of activities, concentration of authority, elements of creative organizations, idea-generator age, years of education, and creative ability as the independent variables, idea-generator age was selected at the first step (R = .47; Signif F = .004), structuring of activities was selected at the second step (R = .58, R^2 Change = .12; Signif F Change = .020; Signif F (Model) = .001), and variable selection terminated.

When all of the covariates of product quantity were controlled by entering them first as a block in the forced entry multiple regression, structuring of activities and concentration of authority when entered next as a block, added 6.2% to the variance, an amount that was not significant (R = .66; R^2 Change = .06; Signif F Change = .22).

When only the covariates of product quantity that were not also covariates of the independent variables were controlled, i.e., idea-generator age and years of education only, by entering them as a block, structuring of activities and concentration of authority entered next in a block added 13.1% to the variance, an amount that was significant (R = .62; R^2 Change = .13; Signif F Change = .0499; DF = 4, 31; Signif F = .004).

Was the relationship between structuring of activities and job structure maintained (Research Question 3) when elements of the environment and characteristics of the workers were controlled? For purposes of this analysis, job structure was chosen as the dependent variable. Elements of creative organizations ($r = .75$; $p = .000$), years of education ($r = -.39$; $p = .019$), and creative ability ($r = -.41$; $p = .014$) covaried with job structure. Of these, elements of creative organizations and creative ability were correlated with the independent variable (STRUCACT), ($r = -.56$; $p = .000$, and $r = .36$; $p = .031$, respectively) (from Table 6). When elements of creative organizations, years of education and creative ability were partialled out of the relationship between structuring of activities and job structure, the correlation became not significant ($r = .07$; $p = .720$; $df = 31$). Therefore, the relationship between structuring of activities and job structure did not endure when elements of the environment and characteristics of the workers were partialled out.

When job structure was the dependent variable in the stepwise regression with structuring of activities, elements of creative organizations, creative ability,

and years of education as the independent variables, elements of creative organizations was selected at the first step ($R = .75$; Signif F = .000), creative ability was selected at the second step ($R = .80$, $R^2 = .63$, R^2 Change = .07, $p = .017$), and variable selection terminated.

When only characteristics of the workers were controlled, i.e., years of education and creative ability, through partial correlation, the relationship between structuring of activities and job structure was significant ($r = -.34$; $p = .048$; $df = 32$).

Years of education was dropped because it did not add significantly to the variance after creative ability was taken into account in the forced entry multiple regression. When creative ability only was partialled out, the correlation was significant ($r = -.36$; $p = .034$). Thus, structuring of activities added 10.8% to the variance in job structure when creative ability alone was taken into account.

Research Question 5

Research Question 5 read "Were organizations that were better at creative performance lower on organizational structure?" Crosstabulation of creative quality by structuring of activities showed some support for an affirmative answer to this research

question, although not significant. Likewise, the crosstabulation of creative quality by concentration of authority showed some support for a relationship (not significant) but in the direction opposite to that predicted.

Crosstabulation of product quantity by structuring of activities resulted in a significant chi-square (χ^2 = 4.32, DF = 1, p = .038), and in the direction predicted. When product quantity was high, 70% of the companies were low on structuring of activities. Of the companies that were low on product quantity, 68.4% were high on structuring of activities.

The crosstabulation of product quantity by concentration of authority suggested a relationship, but in the direction opposite to that predicted, and it was not significant.

Analysis of variance showed a significant difference in mean product quantity for low verses high structuring of activities and in the direction predicted, i.e., the mean product quantity score for low structuring of activities was higher. Table 7 shows the means and standard deviations of the groups and shows the results of the ANOVA. Analyses of variance for product quantity with concentration of authority, and creative quality with structuring of

Table 7

Mean Product Quantity by Structuring of Activities

	N	Mean Product Quantity	Std. Dev.
Structuring of Activities			
Low	18	1.33	1.36
High	18	.45	.36
	36	.89	1.08

Source	Sum of Squares	DF	Mean Square	F	P
Between	7.06	1	7.06	7.12	.012
Within	33.71	34	.99		
Total	40.77	35			

activities and concentration of authority were not significant.

When size, company age, and dependency were taken into account by adding them as covariates, the ANCOVA was still significant (see Table 8).

Research Question 6

Research Question 6 read "Were organizations that were better at creative performance lower on job

Table 8

Analysis of Covariance for Product Quantity by Structuring of Activities With Size, Company Age, and Dependency as Covariates

Source	Sum of Squares	DF	Mean Square	F	P
Covariates	.32	3	.11	.10	.961
Between	5.31	1	5.31	4.93	.034
Within	33.39	31	1.08		

structure?" Crosstabulation of creative quality by job structure showed some support for an affirmative answer to this research question, although not significant. The crosstabulation results for product quantity by job structure showed no relationship. Analyses of variance for product quantity and creative quality with job structure resulted in no significant differences. Therefore, the research question was answered in the negative.

Research Question 7

Research Question 7 read "Did these differences exist even when characteristics of the workers and elements of creative organizations were controlled?" Crosstabulation of product quantity by structuring of activities while controlling for a different covariate of the dependent variable each time, i.e., elements of

creative organizations, idea-generator age, years of education, and creative ability, resulted in some support for an affirmative answer to the research question when controlling for the covariate idea-generator age, but this was not significant. For years of education there was a significant relationship between product quantity and structuring of activities in one category only, i.e., when years of education was low, 87.5% of companies high on product quantity were low on structuring of activities, and 70% of those low on product quantity were high on structuring of activities (Fisher's Exact Test $p = .02$). When years of education was high, there was no relationship.

When creative ability was low, there was support for an affirmative answer to the research question for companies with high product quantity only (i.e., 75% of companies were low on structuring of activities). When creative ability was high, there was support for an affirmative answer to the research question for companies with low product quantity only, (i.e., 75% were high on structuring of activities). The relationship was not preserved when elements of creative organizations were controlled. Given these interactions, there was no overall support for Research Question 7 when controlling for these covariates.

Analysis of covariance for product quantity by structuring of activities produced nonsignificant results with elements of creative organizations, idea-generator age and creative ability as the covariates. (Years of education was dropped as a covariate because it correlated significantly with creative ability ($r = .53$; $p = .001$) and idea-generator age ($r = .38$; $p = .022$), and did not add significantly in the forced entry regression with product quantity as the dependent variable ($R = .61$; R^2 Change = .001; Signif F Change = .84)).

When years of education and idea-generator age were the covariates, i.e., only those covariates of the dependent variable that did not covary with the independent variable, the ANCOVA was significant ($p = .034$) (see Table 9).

When idea-generator age was the only covariate the ANCOVA was significant ($p = .027$) (see Table 10).

When size, company age and dependency were taken into account by entering them along with years of education and idea-generator age as the covariates, the results of the ANCOVA were not significant.

When size, company age and dependency were entered along with idea-generator age as the covariates, the results of the ANCOVA were not significant.

Table 9

Analysis of Covariance for Product Quantity by Structuring of Activities With Years of Education and Idea-generator Age as Covariates

Source	Sum of Squares	DF	Mean Square	F	P
Covariates	7.34	2	3.67	4.45	.020
Between	4.05	1	4.05	4.92	.034
Within	26.37	32	.82		

Table 10

Analysis of Covariance for Product Quantity by Structuring of Activities With Idea-generator Age as the Covariate

Source	Sum of Squares	DF	Mean Square	F	P
Covariates	6.41	1	6.41	7.75	.009
Between	4.45	1	4.45	5.38	.027
Within	27.30	33	.83		

Chapter Five

Discussion

The thirty-nine Saskatchewan firms that participated in this study were small, young, and independent, specializing in electronics and computer software. They employed as idea generators mostly 25 to 34 year old males with bachelors degrees, the majority of whom had had no training in creativity and less than one month's ongoing training in their field. Most idea generators were educated in the field in which they currently worked, had 3 to 10 years experience, and had been with their current employer less than five years.

Assumptions of Normality

Because univariate outliers were found for product quantity, the mean, standard deviation and size of correlation coefficients involving product quantity were possibly inflated. Because product quantity and other variables were skewed, some severely, caution should be taken in interpretation and generalization of these results.

Creative Quality

That creative quality did not correlate with the independent variables, the other dependent variable, nor the intervening variables requires comment.

Possible explanations presented here are intended to raise questions for future research, and are not necessarily valid extrapolations from the current data.

Perhaps all companies were relatively successful at inventing and creating. All of the CEO ratings of success at inventing and creating new products tended to be high and possibly there was not enough variance to observe relationships. Or, perhaps the instrument was not sensitive enough to differentiate more successful from otherwise successful firms.

By virtue of still being in business, these firms could all be defined as successful. Perhaps the range of firms should have included companies which had gone out of business. In the present sample the only chance of including such poor performers (by this definition) would have been if the research happened to be conducted just as they were in their twilight before fading from existence. On the Department of Science and Technology's original list of 95 firms, eight had gone out of business before the investigator conducted the telephone screening. Perhaps they should have been included in the study. Of the 56 firms which were selected and agreed to participate, 17 did not return completed questionnaires. There is no way of knowing whether a disproportionate number of these may have

been failing. Even if a company was failing the personal defense mechanisms of the CEO may have been such that he would not admit it to himself, let alone on a research questionnaire.

There was likely a bias inherent in the CEO's job. To remain at the head of these companies probably required an unrelenting attitude that your company is the best at what it does. Another source of bias may have stemmed from an association, in the CEO's mind, of the investigator with the Department of Science and Technology. Part of the Department's role was to champion these firms and their products. The CEOs may have thought that they were required to "be positive" in return. Perhaps extra steps to emphasize the investigator's alliance with a university should have been taken.

Another interpretation of this nonfinding is that CEOs' opinions of company success at inventing and creating are unrelated to the kinds of variables measured in this study. Perhaps the CEOs' opinions depended on other, possibly external, factors. For example, market and economic conditions, availability of venture capital, ability to transfer their new technology into wide use, knowledge of and access to other advancing technologies, luck, timing, or

pressures bearing on the industries for which their products were targeted, e.g., agriculture, potash, oil, and trucking. The success of these firms was very likely dependent on a complex interplay of many forces and perhaps no one component such as inventing superior products was sufficient to ensure success. For example, Cooper (1986) concluded that new product success was related to the strategy the company adopted for initiating, developing and marketing the innovation. It was expected that many of these external forces were controlled by virtue of studying firms all doing business in the same province. Perhaps even companies in the same province experience these forces differently.

But CEOs' were not asked to rate the overall success of the corporation, they were asked specifically to rate success at inventing and creating, i.e., the first stage of product development. And, they were asked to make differentiations on the merits of their own inventions and creations.

Another possibility that should be considered is that invention and creation in these firms may not have depended on the creativity or inventiveness of the idea generators. Because these companies were small, perhaps the CEO was the main idea generator and hired

people to merely make refinements and develop the product for market. If so, possibly perseverance and precision technical work were required of the "idea generators" and not creativity. This might explain why structural, environmental, and human resources characteristics thought to be related to creative quality did not relate to the CEOs' ratings of success at invention and creation.

The fact that the two dimensions of creative performance were not correlated is understandable. Some companies may have adopted a strategy to produce a high volume of products. Others may have chosen to produce fewer, high quality products.

It is possible that to observe relationships with creative quality would have required combinations of these structural, environmental, and human resources variables. For example, maybe very small companies, which were very low on structuring of activities, high on elements of creative organizations, and employed highly creative idea generators would have been rated more highly on creative quality by the CEOs.

To conclude that these structural variables are completely unrelated to the CEO's assessment of whether the company is successful seems improbable. Therefore one is left to conclude that the measuring device was

not sensitive to the differences, the CEOs all had a bias that their companies were successful, or that the companies represented a limited range of possible creative performance as measured by CEO ratings of success at inventing and creating new products.

These results raise a number of questions. Is there a better measure of creative performance? Would combinations of worker characteristics and environments be related to CEOs' ratings of success? Would the employees' ratings of company success be the same as the CEOs'? What factors are related to the CEOs' ratings of success at inventing and creating new products? Did these companies depend on the "idea generators" more for technical productivity than creative production? Are there characteristics of the CEO, such as education level, experience, management training, personality, or creative ability that are related to his ratings of success? Would CEO ratings of success at inventing and creating new products, and scores on independent variables and covariates be significantly different for companies that had recently gone out of business?

Product Quantity and Structuring of Activities

Now turning attention to the other dimension of creative performance, product quantity was well

dispersed. At the high end of the distribution, one company produced five long-term inventions per idea generator per year, another produced 3.9 and two others produced 2.5. At the other end, two companies produced only .09. In fact, 25% of the companies produced .17 or fewer long term inventions per idea generator per year. This tremendous range is partly explained by sector, i.e., the differences in products and types of industries. The two highest scoring companies were producing computer programs. They produced 10 in two years with only one idea generator each. One of the lowest scoring companies produced electronic instruments. It created and developed only four products in two years with 22 idea generators. The other lowest scoring company produced ten computer programs in two years but employed 50 idea generators. Therefore, a combination of difference in sector and number of idea generators contributed to the very large range of values.

As expected, resources, culture, motivators and enablers were significantly positively related to the quantity of creations and inventions produced. It was not, however, clear whether having these elements in place facilitated product quantity or whether having high product quantity resulted in idea generators

rating their environments high. As Galbraith (1982) wrote, a company's reputation for doing good work was both an attraction and an incentive for workers. The significant correlation did provide validation for the model for elements of creative organizations presented in Chapter Two.

Of the ten worker characteristics, only idea-generator age, years of education and creative ability covaried with product quantity. It seems that whether employees were male or female made no difference. However, there were so few female idea generators in these companies that any effect they had could easily have gone undetected. Whether education was relevant, and the percent of idea generators with graduate degrees made no difference. However, as with female idea generators, there were possibly too few not educated in their current field of employment (15%), or with graduate degrees (20%) to detect any effect. On the other hand, not finding support for workers being educated in their current field of employment may mean having fewer specialties (i.e., more generalists), which would be consistent with the main finding of this study.

It is well established that creativity can be enhanced with training (e.g., Rose & Lin, 1984) and

many methods have been developed for stimulating creativity (Stein, 1974, 1975). Yet in this sample, there was very little training in creativity (52% had had none), and in general, the amount of training idea generators had in creativity did not appear to make a difference in creative performance. There is also a general impression that up to date information and knowledge is essential for creativity (Amabile, 1983b; Galbraith, 1982; Merrifield, 1979) and yet keeping up to date in one's field (i.e., ongoing training) did not relate to creative performance. The majority of idea generators were relatively recent graduates, i.e., 56% had five years or less of experience. Perhaps ongoing training would not become necessary for another five years.

The characteristics of workers that were significantly related to product quantity were negatively related, i.e., when product quantity was high, workers were younger, had fewer years of education, and lower creative ability. Results for idea-generator age were consistent with the notion that creativity and innovation is a "young man's game" (Kidder, 1981), but were contrary to the usual industrial manpower planning goal of having a large contingent of older, more experienced employees.

Results for years of education and creative ability were difficult to explain. However, "fewer years of education," should be put into perspective. This sample of companies had a mean idea-generator years of education of 16 years and a standard deviation of 2.1 years--a highly educated group. Less versus more years of education meant comparing 14 versus 18 years. This would probably mean technologists and bachelors degrees versus those with masters degrees or a second bachelors. Thus, the proper interpretation is that employing more masters or second bachelors degreed people was associated with producing fewer products.

One interpretation of the negative relationship between creative ability and product quantity is that the quality or creative value of the inventions in companies with high quantity may have been low. They may have been only expedient technological or commercial innovations with little scientific merit. In fact, scientific merit was dropped from the CEOs' criteria of success at inventing and creating because it was inconsistent with the other items.

The possibility, raised earlier, that perhaps the CEO was the main idea generator could be argued here. In such a scenario he would have needed workers who were more productive, capable of following instructions

well, and possibly lower on creative ability.

A possible interpretation of the low years of education score is that greater amounts of education, beyond a technology diploma or bachelors degree, inhibited creative output. This must be interpreted carefully because years of education and creative ability were significantly, positively correlated. But perhaps having more years of education inhibited quantity of production in that such workers may have set higher standards for themselves, thus interfering with "getting it out."

These worker characteristics may have been related to product quantity in different ways depending on certain combinations. Perhaps employing more people with graduate degrees who were highly creative resulted in more scientific endeavours but low quantities of them, i.e., few, large, complex, long-term, scientific projects. At the other end, perhaps employing more technologists with lower levels of creativity combined to produce many more technical and easily commercialized products.

Creative ability correlated significantly, positively with structuring of activities. When the creative ability of idea generators was higher, the structuring of activities in the company, as rated by

the CEO was higher. Consequently, the more creative people were found in the more structured organizations. This could have been an artifact of size. The larger companies were more highly structured and also employed more creative idea generators.

Unfortunately, elements of creative organizations and characteristics of the workers not only covaried with the dependent variable, product quantity, but also covaried with the independent variables (organizational structure). Consequently, when the effects of the covariates of the dependent variable were removed, some portion of the effects of the independent variables on the dependent variable was also removed (i.e., that portion of the effect that was associated with the covariates' effects on the independent variables). Thus caution in interpretation of these results is necessary to not rule out the possibility of a relationship that was really there. For Research Questions 1 and 3 involving organizational structure, the covariates of concern were elements of creative organizations and creative ability.

Idea-generator age accounted for more of the variance in product quantity than structuring of activities. Idea-generator age accounted for 20%. Structuring of activities accounted for an additional

12%. This was consistent with the expectation that characteristics of workers would account for more variance in creative performance than structural variables and therefore, needed to be controlled.

Structuring of Activities and Concentration of Authority

Some discussion of structuring of activities and concentration of authority is warranted, and especially their negative relationship.

As it turned out, overall the scores for structuring of activities were low as expected, but the range of scores and large standard deviation still suggested considerable variance among the companies.

Inkson et al. (1970) reported actual data for 14 of 40 industrial manufacturing and service organizations studied from the British Midlands. The mean structuring of activity score for their data was 22.6, twice that reported here. However, the size of the companies in Inkson et al.'s study ranged from 159 to 18,000 employees.

The dispersion of the scores for concentration of authority indicated considerable variance. Pugh et al. (1968) reported a mean of 15.00 and standard deviation of 6.04 for autonomy (using an earlier version of the same 23 items) in 52 industrial manufacturing and service organizations from the British Midlands ranging

in size from 330 to 19,800 employees. Given that size in the present sample was much smaller than in Pugh et al.'s, and that concentration of authority normally varies negatively with size, concentration of authority here should have been much higher than that reported by Pugh et al. In fact, it was slightly smaller. Perhaps technology did influence concentration of authority somewhat and mitigated the effects of size. Also, if concentration of authority was strongly determined by size, one would have expected the distribution to be skewed. Because of the apparently normal distribution, one must conclude that whatever did influence concentration of authority must have been evenly distributed in these firms.

When these companies were more highly structured in terms of predetermining how activities were to be carried out, they were lower on concentration of authority, i.e., authority for more decisions was vested at lower hierarchical levels. This finding is consistent with theory which states that when companies are low on concentration of authority, control is maintained through structuring of activities; when structuring of activities is low, control is maintained through concentrating authority at the top. It was expected however, that in this sample of firms,

structuring of activities and concentration of authority would both be low to maximize creativity.

Perhaps, contrary to expectation, concentration of authority was not as salient for creative production as structuring of activities. That is, structuring of activities needed to be low to stimulate creativity, but concentration of authority could be high or low.

Perhaps concentration of authority needs to be high to stimulate creative production. But these companies were more likely centralized because of their small size. Although not significant, smaller firms tended to have higher product quantity, and be significantly higher on concentration of authority. Being centralized perhaps did not inhibit creativity. This, however, does not provide grounds for concluding that the opposite point of view is warranted, i.e., that centralization of authority is necessary for product quantity. This study did not address cause and effect; all that can be said is that the two covaried positively. Because these firms tended to be small, concentration of authority had less freedom to vary. If firms from a wider range of sizes had been sampled, concentration of authority would have been freer to vary and it would have been possible to observe whether high concentration of authority was linked with high

product quantity even in very large firms.

Those companies which were large, had been in business longer and were part of a larger, parent company, tended to score higher on structuring of activities. This finding is consistent with literature that had previously established these relationships (e.g., Pugh et al., 1969; Inkson et al., 1970). Size had the highest correlation coefficient of the three with structuring of activities. This is also not surprising (Child, 1977; Ford and Slocum, 1977).

Size, company age and dependency were negatively related to concentration of authority and company age had the largest correlation coefficient. Given the strengths of these relationships, concentration of authority was somewhat less influenced by size and dependency than was structuring of activities. Companies that were large, that had been in business longer, and that were part of a larger, parent company, had decentralized decision-making authority. This finding is consistent with previous literature (e.g., Daft, 1983; Hall, 1982; Pugh et al., 1968; Robbins, 1983). As a general rule, when companies grow larger, the volume of decisions requires decentralization because the head of the firm can no longer make them all. Also, when parent companies set up satellites

which are geographically dispersed, decision-making is usually decentralized due to distance and time constraints.

The relationship found here between company age and concentration of authority is more difficult to explain. Perhaps in young companies there was a strong need for the owner or CEO to be in control of all decisions and all processes. In older companies perhaps the CEOs had more confidence in their subordinates (and perhaps had learned about the virtues of delegation as an effective management skill) and decentralized the authority for some decisions.

Job Structure and Creative Performance

Contrary to expectations, the CEOs' ratings of success at inventing and creating, and the number of inventions or creations per idea generator, were independent of whether jobs were rated by idea generators as rich in skill variety, task identity, task significance, autonomy, and feedback.

If the theory and methodology are sound then the fact that the richness of jobs did not vary with creative performance suggests that these jobs were not central to the success of these firms, or if they were central, that the workers could perform effectively whether motivated or not.

The mean for job structure was considerably higher than the national norm reported by Hackman and Oldham (1980). Thus, jobs in these firms were considerably "richer."

Given the emphasis Hackman and Oldham placed on growth need strength as a moderating variable in their model, and given the fact that in this sample of idea generators growth need strength was considerably higher than in Hackman and Oldham's (1980) norming sample, it is particularly puzzling that job structure did not relate to creative performance. One would expect that being well educated, working with leading-edge technologies, and being counted on to be inventive and creative would be just the kinds of workers that Hackman and Oldham would expect to have high growth need strength and for whom job characteristics would be salient.

On the other hand, one could question whether the job characteristics model accounts for all the attributes that relate to motivation, or even whether, more generally, task characteristics are related to motivation and performance. The lack of a relationship in the present study supports the growing body of literature that is critical of this model (O'Brien, 1982; Roberts & Glick, 1981).

As pointed out earlier, potential problems with the methodology for creative quality and the limited sampling range of technology may provide a partial explanation for the lack of a relationship. Both creative quality and job structure were skewed and may not have had enough variance. But, the other measure of creative performance, product quantity, was not normally distributed either and independent variables covaried with it. As well, job structure did correlate with other variables. So a more likely conclusion is that Hackman and Oldham's job characteristics theory as a predictor of performance is open to challenge.

Structuring of Activities and Job Structure

Evidence for a significant relationship between structuring of activities and job structure is an important finding for job characteristics theory because little research has been done to examine job structure in its context (Roberts & Glick, 1981).

The fact that size and dependency were more closely related to structuring of activities than job structure, and job satisfaction was more closely related to job structure than structuring of activities does not necessarily detract from the significance of their mutual relationship. As reported in the review of the literature, size would be expected

to account for more of the variance in structuring of activities than job structure (i.e., technology). After all, size and dependency are the context for organizational structure (Pugh, Hickson, Hinings & Turner, 1969). The fact that job satisfaction was closely related to job structure is consistent with theory. Also, job satisfaction may have been inflated due to common method variance (Roberts & Glick, 1981).

How characteristics of the workers related to job structure is of interest. The more highly educated the idea generators were, the lower they tended to rate their jobs on motivating potential, i.e., the more structured they found their jobs. It could have been that the more highly structured jobs tended to attract or were assigned to more highly educated employees. This seems the antithesis to what would be expected, i.e., that higher educated employees would be left to work more autonomously. But Kohn and Schooler (1983) found that

> bureaucracies hire educated men, give them complex jobs to perform, and then fail to give them as much opportunity for occupational self-direction as their educational attainments and the needs of the work allow (p. 50).

The literature on professionals (Hall, 1982) would

suggest that a more professional work force should have less structuring of activities because their education would provide them with an internal structure. Perhaps in these companies idea generators were following precise scientific methods or company procedures with less autonomy, greater job segmentation, and more routine. Some processes, for example, debugging electronic equipment, may have required an educational credential but the work may have been very technical and structured. Another possible explanation for the negative relationship between years of education and job structure is that it may have simply been an artifact of their joint relationship with creative ability.

Organizations that were rated higher on the extent of resources, culture, motivators and enablers were high on richness of jobs (i.e., low on job structure). The magnitude of the correlation coefficient was large suggesting, as one interpretation, a great deal of overlap in what the two instruments measured. It is also possible that job structure and elements of creative organizations were both sensitive to the halo effect of job satisfaction which correlated significantly with both. On the other hand, it is possible that to the extent employees felt like

resources, culture, motivators and enablers were present, they truly felt like skill variety, task identity, task significance, autonomy and feedback were present. But, many of the dimensions measured by these two instruments overlapped. For example, the motivator of "big, important opportunities" measured by the elements instrument was represented by task significance and task identity on the job structure instrument. The enabler of freedom was represented by autonomy. The enabler of communication/information flow contained the notion of feedback. Thus, the large correlation may have been due to the two instruments measuring similar constructs, and to common method variance.

Therefore, to remove the effects of elements of creative organizations was to remove almost all the effects of job structure. But not all. Interestingly enough, creative ability still accounted for a significant variance of 7% in job structure after the effects of elements of creative organizations had been removed. It would seem that the creative ability of idea generator's was important, although small in determining the level of job structure.

Idea generators who were more creative tended to find jobs less rich than less creative idea generators.

Did creative people who found themselves in the least rich jobs tend to rate them lower, or were they hired for their creative ability but then over-controlled in their job assignments? Unfortunately, the present study did not go beyond identifying the negative relationship. It was also found that idea generators who were more creative were less satisfied with their jobs. The most satisfied idea generators had jobs that were the richest. Therefore, job satisfaction may have accounted for the relationship between job structure and creative ability. Either employees who were more creative were dissatisfied with their jobs and tended to rate them as more structured, or they were in more structured jobs, and were thus dissatisfied.

Conclusions

In conclusion, the Saskatchewan firms that participated in the present study were small, young, and independent. They specialized mostly in computer software and electronics.

The major finding of this study was that product quantity was related to structuring of activities. When product quantity was high, structuring of activities was low. This relationship existed even when size, company age, and dependency were controlled. Idea-generator age accounted for more variance in

product quantity than structuring of activities. But, structuring of activities still accounted for a significant portion of the variance in product quantity (i.e., about 12%) after idea-generator age had been taken into account.

No relationship existed between job structure and creative performance. When it came to product quantity, whether jobs were rich or not was irrelevant. Hackman and Oldham's job characteristics theory would appear to be open to challenge.

There was a relationship between job structure and structuring of activities. When structuring of activities was lower, jobs were richer. When elements of creative organizations, years of education, and creative ability were controlled the relationship no longer existed. Job structure was more closely related to job satisfaction than to structuring of activities. Structuring of activities was more closely related to size and dependency than to job structure. Job structure was also more closely related to elements of creative organizations and creative ability than to structuring of activities. Elements of creative organizations and job structure were very similar constructs, and there measures suffered from common method variance.

The CEOs in these companies thought their companies were successful. They estimated that on average they produced one long-term invention or creation per idea generator per year. The CEOs' ratings of success at inventing and creating new products did not relate, linearly, with the other dependent variable, the independent variables, or the intervening variables. The CEOs' ratings were consistently high. This was due to either bias, limited sampling range, or inability of the instruments to discriminate among the firms.

Size, company age, and dependency were all positively correlated with organizational structure. Companies that were larger, that had been in business longer, and that were part of a larger, parent company scored the highest on structuring of activities and the lowest on concentration of authority. Of the covariates of organizational structure, size had the greatest impact on structuring of activities.

Structuring of activities had more influence than concentration of authority on creative performance. Creative performance was linearly independent of size, company age, and dependency.

When the extent of resources, culture, motivators,

and enablers for creativity was high, product quantity was high. Thus, support was found for the model for elements of creative organizations presented in the review of the literature.

High product quantity was also observed when idea generators were younger, were less educated, and had lower creative ability. Of these, idea-generator age had the strongest relation to product quantity, even stronger than elements of creative organizations.

Implications

Managers can expect companies producing high quantities of long-term inventions or creations per idea generator per year to be low on structuring of activities, i.e., to have few specialized functions and few role defining documents. Managers can expect that this relationship will hold regardless of size, company age, or dependency. Even though the age of the workers accounted for considerably more variance in product quantity, managers who have inherited a work force that is not young, should still expect to see some effects on product quantity attributable to structuring of activities being low.

The results have not demonstrated that by decreasing structuring of activities managers can increase product quantity. All that can be said is

that the two covary. But because there is a relationship, research to identify whether adjusting one will influence the other should be a fruitful next step.

Government agencies with a mandate to stimulate creativity and innovation should provide educational material, training and management consulting to assist CEOs to understand and implement appropriate structures. These agencies need also to take a lesson from this research and not inundate companies with requests for formal documentation, role definition and specializations as a condition of support.

Another implication of this study is that managers can expect that when workers are older, more highly educated, and more creative, fewer long-term inventions and creations will be produced per idea generator per year. Further research is required to determine the nature and quality of productions from younger, less educated, lower creative workers verses those of older, more educated, more highly creative workers.

The true nature of the work being performed, i.e., creative or technical, is key to continuing this line of research. The structures being studied are predicted to be significant for creative work. Other

structures entirely may be required for technical work.

It would be easy to conclude that of the two organizational structure dimensions, structuring of activities was the only important one. However, it can not be ignored that concentration of authority did relate to product quantity. Although the correlation was negative, concentration of authority was not as high in this sample as it perhaps could have been given the small size of these companies. This implies that something else may have caused it to be lower. Was it the influence of the technology? Was it a strategy of management? Further investigation is required to answer these questions.

Product quantity was unrelated to how large, how old or how dependent the companies were. But one could argue that it did relate in a round about way. Size, company age, and dependency did relate to structuring of activities, and structuring of activities was related to product quantity. This implies that companies in this sample that were small, young, and independent could expect to be low on structuring of activities, and if low on structuring of activities, they could expect to be high on product quantity.

The significant relationship found between product quantity and the elements of creative

organizations, implies that the variables identified in the climate for creativity, and climate for innovation literature are predictors of product quantity. Where the extent of resources, culture, motivators, and enablers for creativity are high, managers can expect that product quantity will also be high, and vice versa. Therefore, because these climate factors are related to product quantity, their effects must be controlled in some manner if the effects of structure are to be isolated. However, future research should attempt to reduce the common variance between measures of these elements of creative organizations and organizational structure.

The high intercorrelations among employee ratings of job dimensions, elements of creative organizations, and job satisfaction imply that the affective component--job satisfaction--must be controlled when examining the relationship between the other two. It also implies that attempts must be made to reduce common method variance in future research with these constructs.

Apparently knowledge about the richness of jobs is not useful in predicting product quantity, and can therefore be disregarded. But it must be remembered that idea-generator jobs in these Saskatchewan firms

were very rich. Although job structure did not relate to product quantity it is unlikely that it is unimportant. Another implication is that Hackman and Oldham's job characteristics model needs further development to determine whether it is truly inclusive of all the job attributes that relate to performance.

This research did not rule out the possibility of a curvilinear relationship between job structure and product quantity. Up to a certain level was low job structure facilitative of the kind of business these firms were in and after that did low job structure detract? Was this the point at which high volume gave way to higher quality? More research is needed to answer this question, and explore the possibility of a curvilinear relationship between job structure and product quantity.

There was a relationship between rich jobs and structuring of activities. This implies that when there are fewer specializations and fewer role defining documents managers can expect that employees will find jobs richer. Size, dependency, and job satisfaction cause problems with the relationship between structuring of activities and job structure because so much of the variance in job structure is related to job satisfaction, and the variance in structuring of

activities is related to size and dependency.

Another implication of this study is that the CEO's ratings of company success at inventing and creating new products were of little value. CEOs and researchers must look beyond the CEO's assessment for other indicators of how well companies are performing. The limited utility of this criterion challenges the validity of Cooper's (1986) original research wherein he relied on CEO ratings.

Since this was a preliminary study it simply examined whether there were relationships. Subsequent studies should examine combinations of these variables and attempt to establish causal relationships. Does decreasing structuring of activities result in a corresponding increase in product quantity? In what ways do companies that are high on both quantity and quality differ from those that are low on both? How do the companies that were low on structuring of activities and low on concentration of authority differ from those that were high on both? What difference would be found between these companies and companies that had recently gone out of business?

The implication of this study for situational determinants of behaviour is that the structure of the situation can be expected to account for a small but

significant amount of the variance in behaviour.

Although generalizations to other companies that are engaged in creating and inventing new products can only be made with caution, and speculation about creative performance in completely different settings is likely unfounded, the results of this study have implications at least, for research in other settings. One would expect to find more effective classrooms for the gifted to have fewer subject specializations, and fewer curriculum and course guides, for teachers as well as students. Schools or university faculties, or parts thereof, emphasizing creativity should have few specialized faculty and few formalized functions and activities. Any enterprise that depends on the creative products or responses of its workers should have few specializations and role defining documents in order to stimulate and maintain creativity.

Does the dependent variable used here, product quantity, have a parallel in general problem solving? If so, can low structuring of activities be related to performance of all cognitive work. Exploring the effects of structure in organizations that are engaged in inventing and creating new products, and in other settings, would appear to be a worthwhile pursuit.

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Appendix A

Questionnaire Booklet for Chief Executive Officers

Questionnaire for

CEO

When completed please mail to me in the self-addressed envelope.

Rod Brandvold
364 Hinton Avenue South
Ottawa, Ontario
K1Y 1A5

613-729-9039 (Home)
613-722-2300 (Work, afternoons)

I. CRITERIA FOR SUCCESS OF ORGANIZATIONS AT CREATIVITY AND INVENTION

You are being asked to provide estimates and ratings of the success of your company at creating and inventing new products.

Company being rated _____ Rater _____

1. Approximately what percentage of inhouse inventions or creations have been successful? _____%

2. Approximately what percentage of inhouse inventions or creations have been failures? _____%

3. To what extent have your new product programs met their performance objectives? (Circle the number which represents most accurately your rating.)

0-----1-----2-----3-----4-----5-----6-----7----8-----9-----10
Not at all — Totally & absolutely

4. Approximately what percentage of inhouse inventions or creations have been "killed"? _____%

5. To what extent do the revenues from inhouse inventions and creations exceed their costs?

0-----1-----2-----3-----4-----5-----6-----7----8-----9-----10
Costs greatly exceed revenues — Break-even — Revenues greatly exceed costs

6. Approximately how many new products were created or invented inhouse in the past two years? _____

7. From inception to prototype, what percent were:

long term? _____% (i.e., taking months or years)
mid term? _____% (i.e., taking weeks or months)
short term? _____% (i.e., taking day(s) or week(s))

8. Approximately how many people work as inventors or creators during each of the following product stages:

Idea generation? _____ Development? _____ Trials? _____ Production? _____

9. How would you rate the successfulness of your inhouse inventions and creations compared to competitors?

0-----1-----2-----3-----4-----5-----6-----7----8-----9-----10
Highly inferior — Highly superior

Pooling together all the new products created or invented inhouse in the last two years, rate the extent to which they demonstrated:

Scientific merit

10. Major scientific breakthroughs contributing to fundamental knowledge of products or responses in their field(s). Not at all — Extremely high
0--1--2--3--4--5--6--7--8--9--10

Technical merit

11. Potential for manufacture or use in Canada. 0--1--2--3--4--5--6--7--8--9--10
12. Ease of adaptation by industry or industries. 0--1--2--3--4--5--6--7--8--9--10
13. Sound engineering. 0--1--2--3--4--5--6--7--8--9--10
14. Positive impact on productivity. 0--1--2--3--4--5--6--7--8--9--10
15. Impact on reducing manufacturing costs. 0--1--2--3--4--5--6--7--8--9--10

Commercial merit

16. Potential for large domestic market. 0--1--2--3--4--5--6--7--8--9--10
17. Extensive spinoff benefits. 0--1--2--3--4--5--6--7--8--9--10
18. Potential for exports. 0--1--2--3--4--5--6--7--8--9--10
19. Sound design. 0--1--2--3--4--5--6--7--8--9--10
20. Licensing opportunities. 0--1--2--3--4--5--6--7--8--9--10

21. How successful is this company at invention and creation of new products?

0-----1-----2-----3-----4-----5-----6-----7----8-----9-----10
Extremely ineffective — Extremely effective

Please turn the page to the next part.

II. ORGANIZATIONAL STRUCTURE: Short Form

This part of the questionnaire is concerned with various aspects of organizations.

When filling it out refer to the company (or work unit) of which you are the head. If this is part of a larger company, it is important that your answers be based on only your part, i.e., the part of which you are the head. The term "company" is used to refer to the organization (or work unit) that you head.

Name of company _____

Name of larger company that this is a part of (if any). _____

A. FUNCTIONAL SPECIALIZATION

Following is a list of 16 functions that may or may not be specialized in your company.

Definition: A function is specialized when atleast one person performs that function and no other function.

In the list below, place a check mark beside each function for which a specialist (as defined above) exists in your company.

Note: If your company is part of a larger organization, remember to restrict your check marks to only those specialists which exist within your company, i.e., the part of the organization of which you are the head.

Do not take into account the specialist's status, nor whether you have many specialists or only one.

Functions

_____ 1. Develop, legitimize and symbolize the company's charter (i.e., public relations, advertising, etc.)

_____ 2. Dispose of, distribute and service the output (i.e., sales and service, customer complaints, etc.)

_____ 3. Carry outputs and resources from place to place (i.e., transport)

_____ 4. Acquire and allocate human resources (i.e., employment, etc.)

_____ 5. Develop and transform human resources (i.e., education and training)

_____ 6. Maintain human resources and promote their identification with the company (i.e., benefits, medical, safety, magazine, sports and social, etc.)

_____ 7. Obtain and control materials and equipment (i.e., buying, material control, stores, stock control, etc.)

(The list of Functions continues on the next page.)

_____ 8. Maintain and erect buildings and equipment (i.e., maintenance, works engineer, etc.)
_____ 9. Record and control financial resources (i.e., accounts, costs, wages, etc.)
_____10. Control the workflow (i.e., planning, progressing, etc.)
_____11. Control the quality of materials, equipment, and outputs (i.e., inspection, testing, etc.)
_____12. Assess and devise ways of producing the output (i.e., work study, operations research, rate-fixing, methods study, etc.)
_____13. Devise new outputs, equipment, and processes.
_____14. Develop and operate administrative procedures (i.e., registry, filing, statistics, O & M)
_____15. Deal with the legal and insurance requirements (i.e., legal, registrar, insurance, licensing, etc.)
_____16. Acquire information on the operational field (i.e., market research)

B. ROLE-DEFINING DOCUMENTS

Which of the following documents exist in your company? Where requested, also indicate the extent of their application or distribution.

Note: Remember to restrict your answers to only documents within your company.

Also note, the phrase "chief executive" refers to you, the head of this company.

1. Information booklets for employees exist: [] Yes [] No
If yes, how many?
_____ One
_____ Two
_____ Three
_____ Four or more

2. Information booklets are given to:
_____ All employees
_____ Many employees
_____ Few employees
_____ None

3. Organization chart(s) exists: [] Yes [] No
If yes, it is given to
_____ Chief executive only
_____ Chief executive plus one other executive
_____ Chief executive plus all/most department heads

4. Written operating instructions exist: [] Yes [] No

(Continued on next page.)

5. Written terms of reference or job description(s) exists:

For direct workers:	[] Yes	[] No
For line superordinates:	[] Yes	[] No
For staff (other than line superordinates)	[] Yes	[] No
For chief executive	[] Yes	[] No

6. Manual of procedures exists: [] Yes [] No

7. Written policies exist: [] Yes [] No

8. Workflow (production) schedules or programs exist: [] Yes [] No

9. Written research program or reports exist: [] Yes [] No

C. AUTONOMY

Below is a list of decisions that certain people at certain levels in companies may or may not have the authority to make.

First, check which of the following applies to you:

[] 1. My company (i.e., the part of which I am the head) is part of a larger company.

If this applies to you, in the list below, place a check mark beside each decision that must be made at a level of authority above your own, i.e., the decision must be made outside this company.

[] 2. My company (i.e., the part of which I am the head) is an independent business, not part of any larger company.

If this applies to you, in the list below, place a check mark beside each decision that must be made at your level of authority, i.e., the decision must be made by you.

Decisions

_____ 1. Supervisory establishment
_____ 2. Appointment of supervisory staff from outside the organization
_____ 3. Promotion of supervisory staff
_____ 4. Salaries of supervisory staff
_____ 5. To spend unbudgeted or unallocated money on capital items
_____ 6. To spend unbudgeted or unallocated money on revenue items
_____ 7. What type, or brand, new equipment is to be
_____ 8. To determine a new product or service
_____ 9. To determine marketing territories covered
_____10. The extent and type of market to be aimed for
_____11. What shall be costed

(The list of Decisions continues on the next page.)

_____12. What shall be inspected
_____13. What operations shall be work studied
_____14. Dismiss a supervisor
_____15. Training methods to be used
_____16. Buying procedures
_____17. Which suppliers of materials are to be used
_____18. What and how many benefits are to be provided
_____19. The price of the output
_____20. To alter responsibilities/areas of work of specialist departments
_____21. To alter responsibilities/areas of work of line departments
_____22. To create a new department
_____23. To create a new job

Appendix B

Questionnaire Booklet for Idea Generators

Questionnaire for

EMPLOYEES

of High Tech Firms

This questionnaire is part of a research project being conducted by me through the University of Alberta into various aspects of organizational structure and job design in high technology firms.

Please complete it and mail it to me in the envelope provided. No one except me will have access to your answers. Also, all data will be grouped and treated collectively; individual answers will not be revealed. If you have difficulty with any of the questions and would like help, please call me at 613-729-9039 (home) or 613-722-2300 (work, afternoons).

The questionnaire is intended to collect data from people working in high tech firms across a variety of industries and situations. Consequently, it may not fit your situation exactly. Attempt to answer the questions as best you can to reflect your work related to inventing, creating, designing or developing new products, new services, new solutions, or conducting scientific research.

Thank you for your anticipated cooperation and willingness to participate.

Rod Brandvold
Ph.D. Candidate

I. JOB CHARACTERISTICS SURVEY

On the following pages you will find several different kinds of questions about your job. Specific instructions are given at the start of each section. Please read them carefully. It should take no more than 40 minutes to complete the entire questionnaire. Please move through it quickly.

The questions are designed to obtain your perceptions of your job and your reactions to it.

There are no trick questions. Your individual answers will be kept completely confidential. Please answer each item as honestly and frankly as possible.

Thank you for your cooperation.

SECTION ONE

This part of the questionnaire asks you to describe your job, as objectively as you can.

Please do not us this part of the questionnaire to show how much you like or dislike your job. Questions about that will come later. Instead, try to make your descriptions as accurate and as objective as you possibly can.

A sample question is given below.

A. To what extent does your job require you to work with mechanical equipment?

1	2	3	4	5	6	7
Very little; the job requires almost no contact with mechanical equipment of any kind.			Moderately			Very much; the job requires almost constant work with mechanical equipment.

You are to circle the number which is the most accurate description of your job.

If, for example, your job requires you to work with mechanical equipment a good deal of the time -- but also requires some paperwork -- you might circle the number six, as was done in the example above.

If you do not understand these instructions, please ask for assistance. If you do understand them, turn the page and begin.

1. How much autonomy is there in your job? That is, to what extent does your job permit you to decide on your own how to go about doing the work?

1--------2--------3--------4--------5--------6--------7

Very little; the job gives me almost no personal "say" about how and when the work is done.

Moderate autonomy; many things are standardized and not under my control, but I can make some decisions about the work.

Very much; the job gives me almost complete responsibility for deciding how and when the work is done.

2. To what extent does your job involve doing a "whole" and identifiable piece of work? That is, is the job a complete piece of work that has an obvious beginning and end? Or is it only a small part of the overall piece of work, which is finished by other people or by automatic machines?

1--------2--------3--------4--------5--------6--------7

My job is only a tiny part of the overall piece of work; the results of my activities cannot be seen in the final product or service.

My job is a moderate-sized "chunk" of the overall piece of work; my own contribution can be seen in the final outcome.

My job involves doing the whole piece of work from start to finish; the results of my activities are easily seen in the final product or service.

3. How much variety is there in your job? That is, to what extent does the job require you to do many different things at work, using a variety of your skills and talents?

1--------2--------3--------4--------5--------6--------7

Very little; the job requires me to do the same routine things over and over again.

Moderate variety.

Very much; the job requires me to do many different things, using a number of different skills and talents.

4. In general, how significant or important is your job? That is, are the results of your work likely to significantly affect the lives or well-being of other people?

1--------2--------3--------4--------5--------6--------7

Not very significant; the outcomes of my work are not likely to have important effects on other people.

Moderately significant

Highly significant; the outcomes of my work can affect other people in very important ways.

5. To what extent do managers or co-workers let you know how well you are doing on your job?

1	2	3	4	5	6	7
Very little; people almost never let me know how well I am doing.		Moderately; sometimes people may give me "feedback"; other times they may not.				Very much; managers or co-workers provide me with almost constant "feedback" about how well I am doing.

6. To what extent does doing the job itself provide you with information about your work performance? That is, does the actual work itself provide clues about how well you are doing -- aside from any "feedback" co-workers or supervisors may provide?

1	2	3	4	5	6	7
Very little; the job itself is set up so I could work forever without finding out how well I am doing.		Moderately; sometimes doing the job provides "feedback" to me; sometimes it does not.				Very much; the job is set up so that as I work I get almost constant "feedback" about how well I am doing.

SECTION TWO

Listed below are a number of statements which could be used to describe a job.

You are to indicate whether each statement is an accurate or an inaccurate description of your job.

Once again, please try to be as objective as you can in deciding how accurately each statement describes your job -- regardless of whether you like or dislike your job.

Write a number in the blank beside each statement, based on the following scale:

How accurate is the statement in describing your job?

1	2	3	4	5	6	7
Very Inaccurate	Mostly Inaccurate	Slightly Inaccurate	Uncertain	Slightly Accurate	Mostly Accurate	Very Accurate

_____ 1. The job requires me to use a number of complex or high-level skills.

_____ 2. The job is arranged so that I do not have the chance to do an entire piece of work from beginning to end.

_____ 3. Just doing the work required by the job provides many chances for me to figure out how well I am doing.

1	2	3	4	5	6	7
Very Inaccurate	Mostly Inaccurate	Slightly Inaccurate	Uncertain	Slightly Accurate	Mostly Accurate	Very Accurate

_____ 4. The job is quite simple and repetitive.

_____ 5. The supervisors and co-workers on this job almost never give me any "feedback" about how well I am doing in my work.

_____ 6. This job is one where a lot of other people can be affected by how well the work gets done.

_____ 7. The job denies me any chance to use my personal initiative or judgement in carrying out the work.

_____ 8. Supervisors often let me know how well they think I am performing the job.

_____ 9. The job provides me with the chance to completely finish the pieces of work I begin.

_____10. The job itself provides very few clues about whether or not I am performing well.

_____11. The job gives me considerable opportunity for independence and freedom in how I do the work.

_____12. The job itself is not very significant or important in the broader scheme of things.

SECTION THREE

Now please indicate how satisfied you are with each aspect of your job listed below. Once again, write the appropriate number in the blank beside each statement.

How satisfied are you with this aspect of your job.

1	2	3	4	5	6	7
Extremely Dissatisfied	Dissatisfied	Slightly Dissatisfied	Neutral	Slightly Satisfied	Satisfied	Extremely Satisfied

_____ 1. The amount of job security I have.

_____ 2. The amount of pay and fringe benefits I receive.

_____ 3. The amount of personal growth and development I get in doing my job.

_____ 4. The people I talk to and work with on my job.

1	2	3	4	5	6	7
Extremely Dissatisfied	Dissatisfied	Slightly Dissatisfied	Neutral	Slightly Satisfied	Satisfied	Extremely Satisfied

_____ 5. The degree of respect and fair treatment I receive from my boss.

_____ 6. The feeling of worthwhile accomplishment I get from doing my job.

_____ 7. The chance to get to know other people while on the job.

_____ 8. The amount of support and guidance I receive from my supervisor.

_____ 9. The degree to which I am fairly paid for what I contribute to this organization.

_____10. The amount of independent thought and action I can exercise in my job.

_____11. How secure things look for me in the future in this organization.

_____12. The chance to help other people while at work.

_____13. The amount of challenge in my job.

_____14. The overall quality of the supervision I receive in my work.

_____15. All in all, how satisfied would you say you are with your job?

SECTION FOUR

Listed below are a number of characteristics which could be present on any job. People differ about how much they would like to have each one present in their own jobs. We are interested in learning <u>how much you personally would like</u> to have each one present in your job.

Using the scale below, please indicate the <u>degree</u> to which you would <u>like</u> to have each characteristic present in your job.

NOTE: The numbers on this scale are different from those used in previous scales.

4	5	6	7	8	9	10
Would like having this only a moderate amount (or less)			Would like having this very much			Would like having this <u>extremely</u> much

_____ 1. High respect and fair treatment from my supervisor.

_____ 2. Stimulating and challenging work.

4	5	6	7	8	9	10
Would like having this only a moderate amount (or less)			Would like having this very much			Would like having this extremely much

_____ 3. Chances to exercise independent thought and action in my job.

_____ 4. Great job security.

_____ 5. Very friendly co-workers.

_____ 6. Opportunities to learn new things from my work.

_____ 7. High salary and good fringe benefits.

_____ 8. Opportunities to be creative and imaginative in my work.

_____ 9. Quick promotions.

_____10. Opportunities for personal growth and development in my job.

_____11. A sense of worthwhile accomplishment in my work.

SECTION FIVE

People differ in the kinds of jobs they would most like to hold. The questions in this section give you a chance to say just what it is about a job that is most important to you.

For each question, two different kinds of jobs are briefly described. You are to indicate which of the jobs you personally would prefer -- if you had to make a choice between them.

In answering each question, assume that everything else about the jobs is the same. Pay attention only to the characteristics actually listed.

Two examples are given below.

JOB A
A job requiring work with mechanical equipment most of the day

JOB B
A job requiring work with other people most of the day

1	2	3	4	5
Strongly Prefer A	Slightly Prefer A	Neutral	Slightly Prefer B	Strongly Prefer B

If you like working with people and working with equipment equally well, you would circle the number 3, as has been done in the example.

Here is another example. This one asks for a harder choice -- between two jobs which both have some undesirable features.

JOB A				JOB B
A job requiring you to expose yourself to considerable physical danger.				A job located 200 miles from your home and family.
1	2	3	4	5
Strongly Prefer A	Slightly Prefer A	Neutral	Slightly Prefer B	Strongly Prefer B

If you would slightly prefer risking physical danger to working far from your home, you would circle number 2, as has been done in the example.

Please ask for assistance if you do not understand exactly how to do these questions.

	JOB A				JOB B
1.	A job where the pay is very good.				A job where there is considerable opportunity to be creative and innovative.
	1	2	3	4	5
	Strongly Prefer A	Slightly Prefer A	Neutral	Slightly Prefer B	Strongly Prefer B
2.	A job where you are often required to make important decisions.				A job with many pleasant people to work with.
	1	2	3	4	5
	Strongly Prefer A	Slightly Prefer A	Neutral	Slightly Prefer B	Strongly Prefer B
3.	A job in which greater responsibility is given to those who do the best work.				A job in which greater responsibility is given to loyal employees who have the most seniority.
	1	2	3	4	5
	Strongly Prefer A	Slightly Prefer A	Neutral	Slightly Prefer B	Strongly Prefer B

	JOB A	JOB B
4.	A job in an organization which is in financial trouble -- and might have to close down within the year.	A job in which you are not allowed to have any say whatever in how your work is scheduled, or in the procedures to be used in carrying it out.

1	2	3	4	5
Strongly Prefer A	Slightly Prefer A	Neutral	Slightly Prefer B	Strongly Prefer B

	JOB A	JOB B
5.	A very routine job.	A job where your co-workers are not very friendly.

1	2	3	4	5
Strongly Prefer A	Slightly Prefer A	Neutral	Slightly Prefer B	Strongly Prefer B

	JOB A	JOB B
6.	A job with a supervisor who is often very critical of you and your work in front of other people.	A job which prevents you from using a number of skills that you worked hard to develop.

1	2	3	4	5
Strongly Prefer A	Slightly Prefer A	Neutral	Slightly Prefer B	Strongly Prefer B

	JOB A	JOB B
7.	A job with a supervisor who respects you and treats you fairly.	A job which provides constant opportunities for you to learn new and interesting things.

1	2	3	4	5
Strongly Prefer A	Slightly Prefer A	Neutral	Slightly Prefer B	Strongly Prefer B

	JOB A	JOB B
8.	A job where there is a real chance you could be laid off.	A job with very little chance to do challenging work.

1	2	3	4	5
Strongly Prefer A	Slightly Prefer A	Neutral	Slightly Prefer B	Strongly Prefer B

	JOB A				JOB B
9.	A job in which there is a real chance for you to develop new skills and advance in the organization.				A job which provides lots of vacation time and an excellent fringe benefit package.
	1	2	3	4	5
	Strongly Prefer A	Slightly Prefer A	Neutral	Slightly Prefer B	Strongly Prefer B
10.	A job with little freedom and independence to do your work in the way you think best.				A job where the working conditions are poor.
	1	2	3	4	5
	Strongly Prefer A	Slightly Prefer A	Neutral	Slightly Prefer B	Strongly Prefer B
11.	A job with very satisfying teamwork.				A job which allows you to use your skills and abilities to the fullest extent.
	1	2	3	4	5
	Strongly Prefer A	Slightly Prefer A	Neutral	Slightly Prefer B	Strongly Prefer B
12.	A job which offers little or no challenge.				A job which requires you to be completely isolated from co-workers.
	1	2	3	4	5
	Strongly Prefer A	Slightly Prefer A	Neutral	Slightly Prefer B	Strongly Prefer B

SECTION SIX

Biographical Background

1. Sex

[] Male [] Female

2. What is your age?

[] under 20
[] 20 to 24
[] 25 to 29
[] 30 to 34
[] 35 to 39
[] 40 to 44
[] 45 to 49
[] 50 to 54
[] 55 to 59
[] 60 or over

3. Experience

In total, how much experience have you had doing the type of work you are doing now?

[] less than 6 months
[] 6 months to 1 year
[] 1 to 2 years
[] 3 to 5 years
[] 5 to 10 years
[] 10 to 15 years
[] 15 to 20 years
[] more than 20 years

4. How long have you worked for this company?

[] less than 6 months
[] 6 months to 1 year
[] 1 to 2 years
[] 3 to 5 years
[] 5 to 10 years
[] more than 10 years

5. Training in Creativity

In total, how much training have you attended on techniques for being creative, inventive or innovative in your work? For example, seminars on brainstorming, creative problem solving, synergy, creative thinking, getting new product ideas, etc. (Do not include training received as part of a formal education program.)

[] none
[] less than 2 weeks
[] 2 weeks to 1 month
[] 1 to 2 months
[] 2 to 6 months
[] 6 months to 1 year
[] 1 to 2 years
[] more than 2 years

6. On-going Training

In total, how much on-going training have you attended to keep up to date in your field?

[] none
[] less than 2 weeks
[] 2 weeks to 1 month
[] 1 to 2 months
[] 2 to 6 months
[] 6 months to 1 year
[] 1 to 2 years
[] more than 2 years

7. Education

a) Do you have formal education in the field in which you are currently working?

[] yes [] no

b) What is the total number of years of education you have completed successfully?

[] 8 or less [] 12 to 13 [] 17 to 19
[] 9 to 11 [] 14 to 16 [] 20 or more

c) List the degrees, diplomas or certificates you have been awarded.

_____ _____

_____ _____

_____ _____

_____ _____

8. List below as many uses as you can think of for a brick. (Please limit yourself to 10 minutes.)

(Use back of previous page if you require more space.)

9. Name (optional)_____

Company Name _____

What is your job title? _____

Please turn the page to the next part.

II. ELEMENTS OF CREATIVE ORGANIZATIONS

A number of elements contribute to a company's ability to be inventive and creative. You are being asked to rate the extent to which certain elements are present or are adequate in your company.

You are to circle the number which represents most accurately your rating of each question.

For the first seven questions, use as a frame of reference your opinion of the optimum level needed to ensure top notch creativity and invention. Then rate to what extent, around here:

		Not at all									Totally & absolutely
1.	The amount of money for creativity and invention is adequate?	0	1	2	3	4	5	6	7	8	9	10
2.	Special funds are available for unforeseen projects?	0	1	2	3	4	5	6	7	8	9	10
3.	Facilities and equipment are adequate?	0	1	2	3	4	5	6	7	8	9	10
4.	The quality and quantity of supplies and materials are sufficient?	0	1	2	3	4	5	6	7	8	9	10
5.	The company has enough of the right data and information?	0	1	2	3	4	5	6	7	8	9	10
6.	The company provides enough human resources?	0	1	2	3	4	5	6	7	8	9	10
7.	The human resources possess the right qualities (i.e., technical skills and knowledge, conducive work style, creative bent, and motivation)?	0	1	2	3	4	5	6	7	8	9	10

8. To what extent is there an atmosphere around here of truly valuing and prizing creativity and invention?

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
Not at all — Totally & absolutely

9. To what extent are people expected to be creative and inventive?

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
Not at all — Totally & absolutely

10. To what extent does this company have a reputation for creativity and invention?

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
Not at all — Totally & absolutely

11. To what extent are people given the opportunity to do work that is prestigious and important?

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
Never Always

12. To what extent do people work on projects or products that have a direct bearing on the company's overall success?

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
Never Always

13. To what extent is creativity and invention properly rewarded?

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
Never Always

14. To what extent do people get proper recognition for the work they do?

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
Never Always

15. To what extent are the creators and inventors uninformed about such things as changes in company priorities, user requirements, new product thrusts, etc.? In other words, to what extent does the Nobody-ever-tells-me-anything factor exist around here?

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
Not at all Totally & absolutely

16. To what extent do the creators and inventors get enough information about how well they and their projects are doing?

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
Never Always

17. To what extent do the creators and inventors have full and easy access to include or consult with whomever on whatever information they need in the course of their work?

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
Never Always

18. To what extent do seminars or events occur to exchange ideas (on requirments, problems, opportunities, successes, failures, products, etc.) and to bring together people with similar interests within the company and between companies or other agencies?

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
Never Always

19. To what extent are continuing education, visitations, reading, professional conferences and the like, facilitated?

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
Never Always

20. To what extent are the creators and inventors free to choose which problems and products they work on?

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
Never Always

21. To what extent are the creators and inventors free to apply methods and pursue the solutions to problems and the creation of new products entirely in their own manner?

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
Never Always

22. To what extent does creativity and invention take place in "skunkworks," i.e., free-flowing, intense, basement-like atmospheres where idea people work together and anything goes?

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
Never Always

23. To what extent are these "skunkworks" separated from the rest of the organization?

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
Not at all Totally & completely

24. To what extent are the creators and inventors free to fail without fear of punishment?

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
Never Always

25. To what extent are the creators and inventors always trying out new ideas and starting new projects?

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
Never Always

26. To what extent does a "sponsor" emerge to promote, encourage and facilitate the creation of new products?

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
Never Always

27. To what extent are the creators and inventors buffered from the regular administrative requirements and procedures of the company?

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
Not at all Totally & completely

28. To what extent does somebody with enough power in the company make sure that new products get a chance?

0-----1-----2-----3-----4-----5-----6-----7-----8-----9-----10
Never Always

Appendix C

Announcement Letter Sent to Companies by Deputy Minister

Saskatchewan

Saskatchewan
Science and
Technology

Deputy Minister

Innovation Place, Mall 3
108 Research Drive
Saskatoon, Canada
S7N 2X8

(306) 933-7204
Telex 071-2446

May 21, 1987

Alan Ball, (President)
ABALL Software Inc.
2174 Hamilton Street
Regina SK
S4T 0Y7

Dear Alan:

I am writing to introduce Rod Brandvold to you and ask for co-operation and willingness to participate in his research. Rod Brandvold, is completing his Ph.D. at the University of Alberta in Organizational Psychology, and would like to research certain aspects of organizational and job structure in high technology firms in Saskatchewan.

Unlike many graduate students, Rod Brandvold, has experience in government management and business. In the early days of Science and Technology, he translated departmental goals into job descriptions and a performance evaluation scheme. Rod learned the meaning of risk when involved in running a small business in Saskatoon. He has a good understanding of management, and wants to test certain theories of organization within high technology companies. This is an opportunity for firms in Saskatchewan to be involved in research on high technology management. Born and raised in Saskatchewan, he now lives in Ottawa, and wants to make a contribution to this province through doing his research here.

Rod will telephone you in a week or two. His research involves some questionnaires and a short interview. He understands the need for absolute confidentiality. When it comes to product information, he needs only your rating of your firm's new product success. He will only report on group data and not on individual firms.

In return for your participation, a seminar will be offered in the fall free for those firms that participated. This will be a chance to hear the latest on organizing for high technology, and whether Rod's research found support. While completing his research he is currently working part time doing industrial psychology for a firm in Ottawa. You might ask him for some free consulting as well.

I thank you for your anticipated cooperation.

Sincerely,

Dr. A.J.Y. Guy
Deputy Minister

Appendix D

Table 11

Table 11

Descriptive Statistics for all Variables after Adding Missing Data Estimates

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VARIABLE CRETQUAL Creative Quality

MEAN	7.610	STD DEV	1.456
SKEWNESS	-1.176	S.E. SKEW	.378
MINIMUM	3.36	MAXIMUM	9.50

VALID OBSERVATIONS - 39 MISSING OBSERVATIONS - 0

- -

VARIABLE PRODQUAN Inventions Per Idea Generator Per Year

MEAN	.875	STD DEV	1.042
SKEWNESS	2.521	S.E. SKEW	.378
MINIMUM	.09	MAXIMUM	5.00

VALID OBSERVATIONS - 39 MISSING OBSERVATIONS - 0

- -

VARIABLE STRUCACT Structuring of Activities

MEAN	11.590	STD DEV	8.078
SKEWNESS	.634	S.E. SKEW	.378
MINIMUM	.00	MAXIMUM	34.00

VALID OBSERVATIONS - 39 MISSING OBSERVATIONS - 0

- -

VARIABLE CONCAUTH Concentration of Authority

MEAN	13.718	STD DEV	5.487
SKEWNESS	-.049	S.E. SKEW	.378
MINIMUM	3.00	MAXIMUM	23.00

VALID OBSERVATIONS - 39 MISSING OBSERVATIONS - 0

- -

Table 11 Continued

VARIABLE CMPSHO Company Motivating Potential Score (Job Structure)

MEAN	186.158	STD DEV	43.773
SKEWNESS	.349	S.E. SKEW	.393
MINIMUM	77.62	MAXIMUM	311.11

VALID OBSERVATIONS - 36 MISSING OBSERVATIONS - 3

- -

VARIABLE CELMENT2 Company Elements of Creative Organizations

MEAN	5.955	STD DEV	1.070
SKEWNESS	-.406	S.E. SKEW	.393
MINIMUM	3.33	MAXIMUM	8.50

VALID OBSERVATIONS - 36 MISSING OBSERVATIONS - 3

- -

VARIABLE CSEX Percent Males in Each Company

MEAN	92.424	STD DEV	14.926
SKEWNESS	-1.895	S.E. SKEW	.393
MINIMUM	50.0	MAXIMUM	100.0

VALID OBSERVATIONS - 36 MISSING OBSERVATIONS - 3

- -

VARIABLE CAGE Average Age of Employees in Each Company

MEAN	30.771	STD DEV	4.907
SKEWNESS	.142	S.E. SKEW	.393
MINIMUM	22.00	MAXIMUM	41.17

VALID OBSERVATIONS - 36 MISSING OBSERVATIONS - 3

- -

Table 11 Continued

VARIABLE CEXPRNCE Average Experience of Employees in Each Company

MEAN	5.759	STD DEV	3.437
SKEWNESS	.921	S.E. SKEW	.393
MINIMUM	.88	MAXIMUM	15.00

VALID OBSERVATIONS - 36 MISSING OBSERVATIONS - 3

- -

VARIABLE CTENURE Average Years of Tenure in Each Company

MEAN	3.331	STD DEV	2.547
SKEWNESS	1.462	S.E. SKEW	.393
MINIMUM	.25	MAXIMUM	12.50

VALID OBSERVATIONS - 36 MISSING OBSERVATIONS - 3

- -

VARIABLE CTRNCRET Average Years of Training in Creativity in Each Company

MEAN	.183	STD DEV	.360
SKEWNESS	2.528	S.E. SKEW	.393
MINIMUM	.00	MAXIMUM	1.50

VALID OBSERVATIONS - 36 MISSING OBSERVATIONS - 3

- -

VARIABLE CONGOTRN Average Years of Ongoing Training in Each Company

MEAN	.250	STD DEV	.327
SKEWNESS	1.654	S.E. SKEW	.393
MINIMUM	.00	MAXIMUM	1.26

VALID OBSERVATIONS - 36 MISSING OBSERVATIONS - 3

- -

Table 11 Continued

VARIABLE CRELED Percent of Idea Generators Educated in Current Field in Each Company

MEAN	84.438	STD DEV	24.575
SKEWNESS	-1.678	S.E. SKEW	.393
MINIMUM	.0	MAXIMUM	100.0

VALID OBSERVATIONS - 36 MISSING OBSERVATIONS - 3

- -

VARIABLE CYRSEDUC Average Years of Education in Each Company

MEAN	16.027	STD DEV	2.148
SKEWNESS	-1.307	S.E. SKEW	.393
MINIMUM	8.00	MAXIMUM	20.25

VALID OBSERVATIONS - 36 MISSING OBSERVATIONS - 3

- -

VARIABLE CHYSTED Percent Graduate Degrees in Each Company

MEAN	21.624	STD DEV	34.768
SKEWNESS	1.440	S.E. SKEW	.393
MINIMUM	.0	MAXIMUM	100.0

VALID OBSERVATIONS - 36 MISSING OBSERVATIONS - 3

- -

VARIABLE CCREATVY Average Creative Ability in Each Company

MEAN	23.546	STD DEV	8.295
SKEWNESS	-.080	S.E. SKEW	.393
MINIMUM	3.00	MAXIMUM	40.50

VALID OBSERVATIONS - 36 MISSING OBSERVATIONS - 3

- -

Table 11 Continued

VARIABLE SIZE Number of employees

MEAN	40.359	STD DEV	76.323
SKEWNESS	3.445	S.E. SKEW	.378
MINIMUM	4	MAXIMUM	390

VALID OBSERVATIONS - 39 MISSING OBSERVATIONS - 0

- -

VARIABLE COAGE Number of years in business

MEAN	7.467	STD DEV	5.601
SKEWNESS	1.346	S.E. SKEW	.378
MINIMUM	1	MAXIMUM	25

VALID OBSERVATIONS - 39 MISSING OBSERVATIONS - 0

- -

VARIABLE DPNDCY Independent company or not

MEAN	.154	STD DEV	.366
SKEWNESS	1.996	S.E. SKEW	.378
MINIMUM	0	MAXIMUM	1

VALID OBSERVATIONS - 39 MISSING OBSERVATIONS - 0

- -

VARIABLE CCMBGNS2 Average Growth Need Strength in Each Company

MEAN	5.157	STD DEV	.520
SKEWNESS	-1.188	S.E. SKEW	.393
MINIMUM	3.69	MAXIMUM	5.90

VALID OBSERVATIONS - 36 MISSING OBSERVATIONS - 3

- -

Table 11 Continued

VARIABLE COVRSAT Average Overall Job Satisfaction in Each Company

MEAN	5.254	STD DEV	.674
SKEWNESS	-.542	S.E. SKEW	.393
MINIMUM	3.53	MAXIMUM	6.60

VALID OBSERVATIONS - 36 MISSING OBSERVATIONS - 3

Appendix E

Saskatchewan Companies that Participated in this Study

Saskatchewan Companies that Participated in this Study

The following companies from the Department of Science and Technology's 1987 high-technology list participated in this study.

ABALL Software Inc.
AGTRON Enterprises Inc.
Beline Manufacturing Co. Ltd.
BIOSTAR Inc.
CSP Foods Ltd.
Canadian Seed Coaters Limited
Co-operators Data Services Limited
Cortech Systems Ltd.
D.E.L. Compu-Cable Systems, Inc.
Derges-McPhadden, Systems Division
Develcon Electronics Ltd.
Dynamic Computer Systems Ltd.
GDS & Associates Systems Ltd.
Hoechst Canada Inc., Agriculture Division
Horizon Robotics Systems (Canada) Inc.
Innovative Research Inc.
International Road Dynamics Inc
Joytec Ltd.
Management Systems Limited
Matte Electronics Ltd.
Noran Tel Inc.
Northern Soil Technologies Ltd.
P.O.S. Pilot Plant Corp.
Philom Bios Inc.
Pioneer Computer Systems Inc.
Prairie Systems & Equipment Ltd.
Rogers Engineering Inc.
SED Systems Inc.
SHL Systemhouse Inc.
SCI-TEC Instruments Inc.
Scientific Instrumentation Ltd.
SENSTEK Ltd.
Settler Computer Technologies Inc.
Software Support Ltd.
Sorenson Manufacturing Ltd.
Startco Engineering Ltd.
The Cambrian Engineering Group Ltd.
Western Software Solutions
Western Data Systems Limited